Ministry of Fisheries
Te Tautiaki i nga tini a Tangaroa

DFR2010-02: Appendix One

Research Specifications for the 10-Year Research Programme for Deepwater Fisheries

28 July 2010

New Zealand Government

Introduction

This document accompanies the Request for Proposals (RfP) for the Long term Provision of Deepwater Fisheries Research Services. It provides a detailed specification of the individual research projects that MFish wishes to contract as part of the RfP. This document should be read in conjunction with the RfP and Appendix 2: Research and Management Summaries.

The individual research projects are listed in order of 1) the projects scheduled for delivery during 2010–2011 and 2) projects scheduled for delivery from 2011–2012. Each project specification describes the objectives and rationale for the research proposed. It also details the frequency with which this research will be repeated.

The projects scheduled for delivery during 2010–2011 have already been consulted on for cost recovery purposes (except JMA2010-02). This information can be found on the Ministry of Fisheries website at:

http://www.fish.govt.nz/en-nz/Consultations/Fisheries+Services+and+Levies+for+2010-2011/default.htm?wbc_purpose=Basic&WBCMODE=PresentationUnpublished

PROJECTS STARTING IN 2010/2011

Code	Title
Trawl surveys	
To be contracted from 2011/12	
Acoustic surveys	
CAL2010/01	Calibration of acoustic transducers
CDL2010/01	Biomass estimation of black cardinalfish (CDL2) using acoustic surveys
ORH2010/01	Estimating the abundance of orange roughy using acoustic methods (ORH3B spawning plume)
ORH2010/02	Estimation of the abundance of orange roughy using acoustic methods (ORH3B Northwest)
Ageing projects	
MID2010/01	Routine age determination of hoki and middle depth species from commercial fisheries and trawl surveys
DEE2010/08	Targeted ageing of otoliths from selected deepwater stocks
Stock Assessments	
HOK2010/01	Hoki population modelling and stock assessment
LIN2010/01	Stock assessment of ling
OEO2010/01	Oreo stock assessment
SBW2010/01	Stock assessment of southern blue whiting (SBW6B)
SBW2010/05	Stock assessment of southern blue whiting (SBW6R)
Stock characterisations	
To be contracted from 2011/12	
Scampi camera surveys	
To be contracted from 2011/12	
Aquatic environment	
DAE2010/02	Bycatch monitoring and quantification of deepwater stocks (Year 1–scampi)
DAE2010/03	Ecological risk assessment for deepwater stocks
DAE2010/04	Monitoring the trawl footprint for deepwater fisheries
PRO2010/01	Estimating the nature and extent of incidental captures of seabirds, marine mammals and turtles in New Zealand commercial fisheries

Additional research projects	
DEE2010/03	Develop and test a methodology to estimate cryptic mortalities of endangered, threatened and protected species from deepwater fishing activity
DEE2010/04	Development of a methodology for Environmental Risk Assessments for deepwater fisheries
DEE2010/05	Development of a suite of ecosystem and environmental indicators for deepwater fisheries
DEE2010/06	Design a programme to monitor trends in deepwater benthic communities
JMA2010/02	Design an abundance survey for jack mackerel (JMA7) and middle depth species on the west coast, North Island

PROJECTS STARTING FROM 2011/2012

Code	Title
Trawl surveys	
HOK2010/04	Estimation of hoki and middle depth fish abundance on the West Coast South Island using combined trawl and acoustic surveys
HOK2010/05	Estimation of hoki and middle depth fish abundance on the Chatham Rise using trawl surveys
MDT2010/02	Estimation of hoki and middle depth fish abundance on the Southern Plateau using trawl surveys
ORH2010/06	Estimation of the abundance of orange roughy using trawl surveys (ORH MEC stock)
Acoustic surveys	
JMA2010/01	Estimation of jack mackerel (JMA7) and middle depth fish abundance on the west coast, North Island
HOK2010/03	Estimation of spawning hoki biomass using acoustic surveys (Cook Strait)
OEO2010/02	Estimation of the abundance of smooth oreo in Southland (OEO1)
OEO2010/03	Estimation of the abundance of smooth oreo in OEO4 using acoustic surveys
OEO2010/04	Estimation of the abundance of black oreo in OEO3A using acoustic surveys
ORH2010/03	Estimating the abundance of orange roughy using acoustic methods (ORH3B Puysegur)
ORH2010/04	Estimating the abundance of orange roughy using acoustic and trawl methods (ORH7A)
ORH2010/05	Estimating the abundance of orange roughy using acoustic methods (ORH7B)
SBW2010/02	Biomass estimation of southern blue whiting using acoustic surveys (Bounty Platform)
SBW2010/03	Biomass estimation of southern blue whiting using acoustic surveys (Pukaki Rise)
SBW2010/04	Biomass estimation of southern blue whiting using acoustic surveys (Campbell Islands)
Stock Assessment	
DEE2010/02	Stock assessment of deepwater and middle depth fish stocks
Stock characterisations	
DEE2010/07	Characterisation and fishery monitoring of deepwater and middle depth species

Scampi camera surveys	
SCI2010/02	Estimating the abundance of scampi in SCI1 using photographic surveys
SCI2010/03	Estimating the abundance of scampi in SCI2 using photographic surveys
SCI2010/04	Estimating the abundance of scampi in SCI6A using photographic surveys
SCI2010/05	Estimating the abundance of scampi in SCI3 using photographic surveys
Aquatic environment	
DAE2010/01	Taxonomic identification of benthic samples
Additional research projects	
Additional Research Projects will be tendered annually from 2011/2012	

Project: Calibration of acoustic transducers

Project Code: CAL2010/01

Start Date: Current year

Completion Date: 30 June 2015

Vessel Use: None

Overall Objective:

1. To calibrate echosounders on the commercial vessels used to survey deepwater fish stocks acoustically.

Specific Objectives:

1. To calibrate Simrad ES60 echosounders (or other brands) on commercial vessels which are carrying out acoustic surveys on deepwater and middle depth species.

Rationale

General

In recent years, acoustic methods have been successfully used to gain biomass estimates for aggregations of many New Zealand species from surveys undertaken by commercial vessels. These vessels generally have hull-mounted transducers and complete the acoustic transects in between normal commercial fishing operations.

Calibration

The acoustic systems (e.g. Simrad ES60 echo-sounders, hull-mounted and pole-mounted transducers) will be sphere calibrated (after Foote et al. 1987) before the survey commences and again after the survey if the calibration parameters vary significantly from those of calibrations conducted prior to previous surveys. Calibration probably needs to be done in daylight (to avoid interference from biological scatter in the top 20 m) and requires relatively sheltered conditions and 30 m or more of water depth.

Note: Calibrations of acoustic systems will need to be carried out annually as part of any future monitoring programme using acoustics from industry vessels.

Frequency

This project is scheduled for annual delivery.

Project: Biomass estimation of black cardinalfish (CDL2) using acoustic surveys

Project Code: CDL2010/01

Start Date: Current year

Completion Date:[1] 30 June 2014

Vessel Use: Industry vessel: March-April 2011, 2013

Overall Objective:

1. To estimate the biomass of black cardinalfish (*Epigonus telescopus*) using acoustic surveys from industry vessels.

Specific Objectives:

1. To estimate the biomass of black cardinalfish in 2011 using an acoustic survey from an industry vessel.

2. To determine the target strength of black cardinalfish.

Rationale

General

Black cardinalfish (*Epigonus telescopus*) are a very slow-growing and long-lived deepwater fish that are widely distributed around New Zealand at depths of 300–1100 m. The largest fishery for cardinalfish is off the east coast of the North Island (ECNI) in QMA 2, where about 65% of landings have been taken in most years since 1982 (Ministry of Fisheries 2009). The focus of the fishery is on hills and underwater features, where cardinalfish are targeted, and also caught as bycatch in fisheries for orange roughy, alfonsino, and bluenose (Dunn & Bian 2009). The TACC for CDL2 was 2,223 t from 1998–99 to 2008–09, with annual reported catches from 861 t to 2158 t. There are significant sustainability concerns in CDL2 (Ministry of Fisheries 2009) and the Minister of Fisheries decreased the CDL2 TAC for 2009–10 from 2233 t to 1780 t (with a TACC of 1620 t) as part of a three-year staged reduction of the TAC to allow the stock to rebuild.

There are no published fishery independent biomass estimates for black cardinalfish, and stock assessments have been based on standardised commercial catch per unit effort (CPUE) (Dunn & Bian 2009). The most recent assessment for CDL2 was carried out in 2009 (Dunn 2009) and estimated the stock to be substantially depleted, with biomass in 2008–09 at 12-24% of the virgin biomass level. However, model results were highly uncertain (Dunn 2009).

[1] The completion date refers to the duration of the project up to the point of the first review.

Fishery independent surveys using acoustics may provide a means to measure the biomass of cardinalfish. A pilot survey was conducted in 2010 to look at the feasibility of carrying out the survey from a commercial vessel. A summary of the results was presented to the Deepwater Working Group in April 2010. The survey shows some promise as:

- the cardinalfish form strong targets off the bottom
- aggregations are found on bathymetric features which can be defined in advance
- hotspots are small and can be surveyed quickly
- industry participants picked up survey protocols quickly

However, there were also many problems to be overcome including:

- An unknown proportion of fish are present on hotspots at any one time (varies over days and even hours)
- cardinalfish are very difficult to catch so trawl-based mark identification is difficult
- target strength is poorly known

Objective 1

Further development of the acoustic survey for this species is required. Part of the ongoing work will be to establish survey design and protocols which can be implemented by industry vessel crew (i.e., unsupervised) as part of a monitoring programme.

Objective 2

In situ data on target strength will be collected during the survey. Refining the estimates of target strength will allow the absolute abundance of fish in the aggregations to be determined.

Frequency

This project is scheduled to be repeated in 2012–2013, 2014–2015 and 2017–2018.

Project: Estimation of the abundance of orange roughy using acoustic methods (ORH 3B spawning plume)

Project Code: ORH2010/01

Start Date: Current year

Completion Date: 30 June 2012

Vessel Use: Subject to tender, winter 2011

Overall Objective:

1. To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) in selected areas.

Specific Objective:

1. To estimate the abundance with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy over a short time period for the ORH 3B spawning plume.

Rationale

Although New Zealand catches of orange roughy have dropped to about 11,000 t per year, the fishery on the Chatham Rise in ORH 3B is still very important economically and contributes most of the landings of this species. Based on analyses of all available data, the Chatham Rise has been divided into two areas: the Northwest, and the East and South Rise combined. The centre of the Northwest stock is the Graveyard hills. The centre of the East and South Rise stock is the Spawning Box during spawning, and the southeast corner of the Rise during non-spawning.

Acoustic surveys to estimate the abundance of orange roughy have been completed during the winter spawning period. Because orange roughy lack a swim bladder and have a low target strength relative to other deepwater species, acoustic surveys are restricted to aggregations of fish where the species identification of the mark is known to be almost 100% orange roughy. This situation is found in the spawning plume on the Chatham Rise, which has been surveyed annually since 2002 using a commercial fishing vessel. The estimates of biomass in the plume have decreased since 2002 and the catch limit for the East and South Rise has been set based on the survey estimates of biomass with appropriate allowances for fish not in the spawning grounds at the time of the survey.

The acoustic survey of the spawning plume has become a vital source of information for the management of this stock and is a high priority to continue in particular because the estimates of biomass have been declining.

Objective 1

The aim of this research project is to estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy over a short time period on the ORH 3B spawning plume on the Chatham Rise.

A series of acoustic surveys have been conducted on the plume from 2002 to 2010. The biomass estimates from these surveys have been used in the stock assessment for this area.

Frequency

This project is scheduled for delivery again in 2012–2013, 2014–2015, 2016–2017 and 2018–2019.

Project: Estimation of the abundance of orange roughy using acoustic methods (ORH3B Northwest)

Project Code: ORH2010/02

Start Date: Current year

Completion Date: 30 June 2012

Vessel Use: Subject to tender, winter 2011

Overall Objective:

1. To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) in selected areas.

Specific Objective:

1. To estimate the abundance with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy over a short time period for the Northwest Chatham Rise fishery.

Rationale

The Northwest Chatham Rise orange roughy stock has historically supported one of the more important of the orange roughy fisheries and it has the potential to contribute substantially to long-term sustainable yields now that the fishing down phase is over. The stock assessment was updated in 2006 following a new acoustic survey in 2005 that covered almost the entire northwest Chatham Rise. Biomass estimates from three previous resource surveys were also used in this assessment: a 1996 egg survey and 1999 and 2002 acoustic surveys. The results of all three of these surveys were very uncertain. The assessment was very uncertain and is strongly dependent on the CPUE data for the flat areas. The assessment indicated that the catch limit from this sub-area needed to be reduced. From 1 October 2006 the catch limit for the area was reduced to 750 t.

Acoustic surveys were carried out in the Northwest Chatham Rise in the winters of 1999 and 2002, and a combined trawl and acoustic survey was conducted in the winter of 2005. It is proposed to obtain another biomass estimate for this stock in winter 2011.

Acoustic surveys to estimate the abundance of orange roughy have been completed during the winter spawning period for orange roughy. The most recent survey in 2005 also involved extensive trawling for both species identification in support of the acoustic technique and swept area estimation.

Objective 1

The aim of this research project is to estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy over a short time period on the northwest Chatham Rise.

Three acoustic surveys have been conducted on the northwest Chatham Rise – in 1999, 2002 and 2005. The biomass estimates from these surveys have been used in the stock assessment for this area.

Frequency

This project is scheduled for delivery again in 2012–2013, 2014–2015, 2016–2017 and 2018–2019.

Project: Routine age determination of hoki and middle depth species from commercial fisheries and trawl surveys

Project Code: MID2010/01

Start Date: Current year

Completion Date: 30 September 2013

Vessel Use: None

Overall Objective:

1. To age samples of hoki and middle depth species from the commercial fisheries and the trawl surveys as input data to the stock assessments for these species.

Specific Objectives:

Commercial fisheries

1. To determine the age and size structure of the commercial catches of hoki in the main non-spawning fisheries from samples collected at sea by the Observer Programme.

2. To determine the catch at age of commercial catches of hoki from the WCSI and Cook Strait spawning fisheries from data collected by the Observer Programme and from other sources.

3. To determine the catch at age from hake fisheries in HAK 1, 4 and 7 from samples collected at sea by the Observer Programme.

4. To determine the catch at age from ling fisheries in LIN 3 & 4, 5 & 6 and 7 from samples collected at sea by the Observer Programme, and from other sources.

5. To determine the catch at age from southern blue whiting spawning fisheries in (SBW 6I, 6B and 6R) from samples collected at sea by the Observer Programme, and from other sources.

6. To determine the age and size structure of the commercial catches of jack mackerel (all 3 species) in the JMA7 fishery from samples collected at sea by the Observer Programme.

Trawl surveys

7. To determine the age and size structure of hoki, hake, ling and jack mackerel from the trawl surveys.

Other species in the 10-year Deepwater Research Plan

8. To age other species as required for validation of the ageing technique or for targeted studies to meet specific research requirements.

Rationale

Hoki

Hoki is New Zealand's largest fishery with a TACC of 110,000 t. Although managed as a single stock, in the past hoki have been assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

Historically, the main fishery for hoki has operated from mid-July to late August on the west coast of the South Island (WCSI) and in Cook Strait where hoki aggregate to spawn. Largest catches were previously from the western stock, however, in recent years the fishery has been carried out all year on the Chatham Rise and catches from the eastern stock have increased. This is thought to present a higher risk to the smaller eastern stock. Industry has agreed in the last year to spread the catch to other areas of the fishery.

Because of the importance of this fishery the hoki stock assessment is updated each year with new information from a wide range of data collection and research programmes. Size and age data from the commercial fisheries continue to be crucial inputs into the stock assessment providing information on the strength of recruited cohorts. Catch at age data from the spawning fisheries on the WCSI have been collected every year since 1988. For the non-spawning fisheries on the Chatham Rise and Southern Plateau a time series of catch at age data has also been developed more recently.

Objective 1

Observer Programme coverage will provide samples of length frequency, spawning state and otoliths from the hoki fisheries on the Chatham Rise and Southern Plateau. This objective requires that the otoliths be aged to produce catch at age data for these non-spawning hoki fisheries as input to hoki stock assessments. The sampling design has a target coefficient of variation (c.v.) of 20 % (mean weighted c.v. across all age classes).

Objective 2

Catch at age data from the West Coast South Island and Cook Strait spawning fisheries are required as input to the hoki stock assessments. The tenderer is required to process and read the otoliths and determine the catch at age for male and female hoki from the winter spawning fisheries. The sample design has a target c.v. of 20 % (mean weighted c.v. across all age classes) for catch at age.

Hake

Hake has historically been the most abundant bycatch species in the West Coast South Island hoki fishery. The main target fisheries are in the region of the Snares and Auckland Islands, the Chatham Rise and west coast South Island. Catches have exceeded the level of the TACC for two of the three Fishstocks at some stage during the past 5 years.

Objective 3

Catch at age data from the commercial fishery is used in age-structured models to estimate the year class strength of recent recruitment and the selectivity pattern of the fishery. Samples of otoliths from the Observer Programme will be aged for the main hake fisheries.

Ling

Ling is an important middle depth species taken mainly around the South Island. It supports a substantial bottom longline fishery, a target trawl fishery, and is a major bycatch in middle depth trawl fisheries. Landings in 2008-09 were about 13,000 t with catches well below the TACC in all stocks except LIN 7 (WCSI).

Objective 4

Catch at age data from the commercial fishery is used in age-structured models to estimate the year class strength of recent recruitment and the selectivity pattern of the fishery. Samples of otoliths from the Observer Programme will be aged for the main longline and trawl fisheries in LIN 3 & 4 and LIN 5 & 6. Observer samples from the bycatch of the WCSI and Cook Strait trawl fisheries should also be aged to provide data for these stock assessments.

Southern blue whiting

A time series of catch at age data has been developed for all the fisheries using otolith samples collected by the Observer Programme. Catch at age data provides information on the year class strength of recent recruitment to the fishery. These are important in future predictions of stock biomass and yield.

Objective 5

Catch at age data from the commercial fishery is used in age-structured models to estimate the year class strength of recent recruitment and the selectivity pattern of the fishery. Samples of otoliths from the Observer Programme will be aged for the main SBW fisheries.

Jack mackerel

The jack mackerel fisheries catch three species, the two New Zealand species, *Trachurus declivis* and *T. novaezelandiae*, and the more recently arrived *T. murphyi*. The non-native *T. murphyi* spread into New Zealand waters in the early 1980s and in some years is the dominant species in some areas. Jack mackerels were introduced to the QMS as a species assemblage of the three species *T. declivis* (JMD), *T. novaezelandiae* (JMN) and *T. murphyi* (JMM) under a single species code, JMA.

Landings in JMA 7 represent the greatest proportion of total landings and are mainly taken by chartered trawlers. Landings fluctuated between 17,402 t and 25,880 t from the mid 1980s through the mid 1990s. A recent increase in JMA 7 landings has been attributed to market demand and a lack of availability of preferred species quota as a result of cuts in

quotas for other species. In the last 5 years landings have been close to the TACC level of 32,537 t.

Objective 6

Samples of otoliths from the Observer Programme will be aged for all three jack mackerel species from the JMA7 trawl fishery.

Trawl surveys

Three trawl surveys are proposed in 2010-11, the continuation of the Chatham Rise and Southern Plateau surveys for hoki and the start of a new time series off the WCSI. Two of these surveys will be repeated in 2011-12 and all three will continue in 2012-13.

Objective 7

The surveys will provide otolith samples of the main target species to be aged in this project.

Other species in the 10-year Deepwater Research Plan

In addition to the annual otolith readings required for the core species in Objectives 1 to 7 above, there are two other requirements for otolith ageing in the 10-year Deepwater Research Plan:

- To estimate rates of growth and natural mortality for species where age validation has not been completed previously (i.e. assessment of productivity for each species)
- Targeted ageing studies to meet specific research requirements for fisheries management (i.e. other ageing requirements)

Not all species listed below have been validated using otolith readings. In addition, it is anticipated that there will be other ageing studies required to address specific research questions such as determining the age structure of the catch and catch curve analysis for estimating fishing mortality.

Species for ageing
Alfonsino
Barracouta
Black cardinalfish
Blue mackerel
Frostfish
Gemfish
Lookdown dory
Patagonian toothfish
Redbait
Ribaldo
Rubyfish
Sea perch
Silver warehou
White warehou

Objective 8

A programme of length measurement and otolith sampling will operate in the main fisheries for most species in the 10-year Deepwater Research Plan (Appendix 2). Although otoliths will be collected routinely from the main commercial fisheries for all the deepwater stocks, the processing of these otoliths for age determination for a particular stock will only be as required.

Frequency

This project is scheduled for annual delivery.

Project: Targeted ageing of otoliths from selected deepwater stocks

Project Code: DEE2010/08

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: Not required

Overall Objective:

1. To determine the age distribution of deepwater populations of black oreo (*Allocyttus niger*) and orange roughy (*Hoplostethus atlanticus*) for use in stock assessment.

Specific Objectives:

1. To estimate the age of orange roughy in mid-east coast (ORH MEC) by analysing research samples from the trawl surveys in 1993 and 2010.

2. To estimate the age of orange roughy in Challenger (ORH7A) by analysing research samples from the trawl surveys in 1998 and 2009.

3. To estimate the age of black oreo in OEO3A by analysing research samples from the acoustic surveys in 1997, 2002 and 2006.

Rationale

<u>Orange roughy</u>

Ring counts on orange roughy otoliths have been used to determine the growth rate for the main stocks. However, the presence of a transition zone thought to be associated with the age of first maturity makes accurate ageing difficult, and routine catch at age data is not collected from the commercial fisheries. Consequently year class strength is not usually estimated within the assessment models.

The first two objectives of this project involve limited ageing of samples of orange roughy samples from trawl surveys separated by long time periods in each area. It is thought that the difference in age distribution between the surveys may help in interpretation of the stock structure for MEC orange roughy. In the case of ORH 7A the combined trawl and acoustic survey in 2009 found spawning plumes in the area that had not been seen for many years (since the fish stock declined in abundance). The objective is to age samples from these fish to determine whether they are young fish (new recruits to the spawning population) or older fish that have recolonised the area.

Objective 1 – ORH Mid-east coast (MEC)

Samples of otoliths from the trawl surveys in 1993 and 2010 will be aged and used as an input to the stock assessment model along with the biomass estimates from the time series.

Objective 2 – ORH 7A

Samples of otoliths from the trawl surveys in 1998 and 2009 will be aged and used to interpret the recent increase in abundance of orange roughy in this area.

Oreos

Oreos are managed as a species group, which includes commercial fisheries for black oreo (BOE) and smooth oreo (SSO), as well as non-commercial amounts of spiky oreo (SOR). The South Chatham Rise (OEO 3A and OEO 4) is the main fishing area, but other fisheries occur off Otago-Southland on the east coast of the South Island, in the Puysegur-Snares-Macquarie Ridge area south of the South Island (OEO 1) and in the Bounty-Pukaki area (OEO 6). In 2008-09 reported landings from all stock combined totalled 15,900 t.

The OEO 3A oreo fishery was about 15,400 t in 1980–81 but was reduced to a mean annual catch of 3000 t from 2003–04 to 2008–09 (black oreo makes up abpout half of the annual catch). There have been recent acoustic surveys (1997, 2002 and 2006) and subsequent stock assessments.

Objective 3

The growth rate of both black and smooth oreo are known from otolith readings (validated ages). Routine catch at age data is not generally collected but some age frequency data are available from acoustic and trawl surveys. Year class strength is estimated within some of the assessment models.

The stock assessment model for black oreo (OEO 3A) divides the main fishing grounds into areas 1–3 based on depth. The model uses length as a proxy for age and smaller fish dominate in the shallow area 1 but the acoustic surveys have produced high abundance estimates in area 1 and the application of length based methods instead of age has resulted in high abundance estimates for fish in area 1. The area is not fished commercially so the high abundance may be an artefact of assuming length as a proxy for age.

To allow the further development of the model the otoliths from the acoustic surveys will be aged. This work needs to be completed before the next assessment of black oreo in OEO 3A.

Frequency

This is scheduled for delivery in 2010-2011 only.

Project: Hoki population modelling and stock assessment

Project Code: HOK2010/01

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To determine biomass, long-term sustainable yields and optimum exploitation rates of hoki (*Macruronus novaezelandiae*) stocks and to model the response of hoki stocks to exploitation.

Specific Objectives:

1. To update the stock assessment of hoki in the year 2011, including estimates of biomass, risk and yields.

2. To provide a descriptive analysis of the hoki fishery in the 2009-10 fishing year.

Rationale

Hoki is New Zealand's largest fishery with a current TACC of 110,000 t. Although managed as a single stock, in the past hoki have been assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

Historically, the main fishery for hoki has operated from mid-July to late August on the west coast of the South Island (WCSI) and in Cook Strait where hoki aggregate to spawn. Largest catches were previously from the western stock, however, in recent years the fishery has been carried out all year on the Chatham Rise and catches from the eastern stock have increased. This is thought to present a higher risk to the smaller eastern stock. Industry has attempted to spread the catch to other areas of the fishery in recent years.

Because of the importance of this fishery the hoki stock assessment is updated each year with new information from a wide range of data collection and research programmes. A trawl survey on the Chatham Rise, which measures the abundance of both juvenile and adult hoki, has been carried out in January with *Tangaroa* each year. Another trawl survey of the Southern Plateau is planned for December 2010. Catch at age data from the spawning fisheries on the WCSI and Cook Strait are collected each year. A new assessment of hoki stocks was completed in early 2010 (project HOK2009/01).

The hoki assessment model has developed from a simple age-based stock reduction approach to a complex two-stock spatially disaggregated model, which incorporates all the available data

on hoki abundance over the history of the fishery. This structure is necessary to overcome the problem of the catches from the Chatham Rise where both eastern and western stocks mix.

The update of the hoki stock assessment in 2011 is a high priority.

Objective 1

It is planned to update the stock status of hoki in 2011 and also to evaluate performance indicators for 5-year projections. New abundance indices will be available in 2011 from trawl surveys of Chatham Rise in January 2011 (project HOK2010/02) and of the Southern Plateau in December 2010 (project MDT2010/01). New catch at age data from the spawning and non-spawning fisheries in 2010 will also be available.

Objective 2

The hoki fishery has changed over time in the areas fished, the seasonal distribution of catch and the relative proportion taken from eastern and western stocks. The use of both midwater and bottom trawl and more recently twin–rigged trawls has changed the fishery and made interpretation of the CPUE data very difficult. For many years standardised CPUE analysis was used to provide abundance indices for the various hoki spawning and non-spawning fisheries. However, in recent years these have not been used in the stock assessment model. The objective here is to record changes from previous years in the hoki fishery in 2009-10, for use in stock assessment and management. In addition the "Data collation report" will be updated with new catch information, abundance indices and other hoki data used in the stock assessment.

Frequency

This project is scheduled for annual delivery.

Project: Stock assessment of ling

Project Code: LIN2010/01

Start Date: Current year

Completion Date: 31 May 2012

Vessel Use: None

Overall Objective:

1. To carry out stock assessments of ling (*Genypterus blacodes*) in LIN 3, 4, 5, 6 and 7, including estimating biomass and sustainable yields.

Specific Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data for ling from LIN2 (Cook Strait component only), LIN 3 & 4, 5 & 6, 6B (Bounties) and 7.

2. To update the standardised catch and effort analyses from the ling longline and trawl bycatch fisheries in LIN 2 (Cook Strait component only), LIN 3 & 4, 5 & 6 and 7 with the addition of data up to the end of the 2009/10 fishing year.

3. To update the stock assessment of LIN 3 & 4 including estimating biomass and yields.

Rationale:

Ling is an important middle depth species taken mainly around the South Island. It supports a substantial bottom longline fishery, a target trawl fishery, and is a major bycatch in middle depth trawl fisheries. Some near-shore set net and longline targeting for ling is also conducted. Recreational and Maori customary take of ling is believed to be negligible in all areas.

Following the stock assessment in 2000, the TACCs for LIN 3 and LIN 4 were cut, as the stock appeared to be declining at previous catch levels. However, assessments for most stocks are still uncertain and further work is required to determine appropriate catch levels. From 1 October 2004 the TACCs for LIN 5 and 6 were increased by 20% as the stock assessment model indicated that current catches were not having a measurable impact on stock size. The stock assessment for ling on the WCSI was updated in 2008, and LIN 5&6 will be updated in 2010. Therefore LIN 3&4 will be assessed in 2011 as it is a high priority.

Objective 1

A descriptive analysis for all ling fisheries should be updated to 2009-10 using the commercial catch and effort data. However, LIN 1 is managed under the Adaptive Management Programme and will be reviewed separately.

Objective 2

Catch and effort data will be analysed for the target longline and trawl bycatch fisheries and used to update CPUE series where appropriate. In LIN 6 the longline fishery on the Bounty Platform, which is believed to be a separate stock from the rest of the Southern Plateau (including the Stewart-Snares Shelf and the Puysegur Bank) should be analysed separately.

Objective 3

Abundance indices from trawl surveys and CPUE analyses will be used to update the assessment of LIN 3&4 in 2011. Estimates of biomass and numbers at age will be available from the trawl surveys on the Chatham Rise (LIN 3 & 4) in January 2011 (HOK2010/02). Catch at age data will be available from project MID2010/01, and CPUE indices will be available from Objective 2 of this project for the ling longline fishery on the Chatham Rise.

Frequency

Further assessments of LIN 3 & 4 are scheduled for delivery during 2013–2014, 2016–2017 and 2019–2020.

Project: Oreo stock assessment

Project Code: OEO2010/01

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To carry out a stock assessment of black oreo (*Allocyttus niger*) and smooth oreo (*Pseudocyttus maculatus*), including estimating biomass and sustainable yields.

Specific Objectives:

1. To develop standardised catch per unit effort analyses with inclusion of data up to the end of the 2009-10 fishing year for smooth oreo in OEO4.

2. To update the stock assessment of smooth oreo (OEO4) in the year 2011, including estimates of biomass, risk and yields.

Rationale

The Chatham Rise smooth oreo fishery (OEO 4) is the largest of the fisheries for smooth oreo with recent catches being over 6000 t per year. Oreos are managed as a species group, which includes commercial fisheries for black oreo (BOE) and smooth oreo (SSO), as well as non-commercial amounts of spiky oreo (SOR). The South Chatham Rise (OEO 3A and OEO 4) is the main fishing area, but other fisheries occur off Otago-Southland on the east coast of the South Island, in the Puysegur-Snares-Macquarie Ridge area south of the South Island (OEO 1) and in the Bounty-Pukaki area (OEO 6). In 2008-09 reported landings from all stock combined totalled nearly 17 000 t. The OEO 4 fishery is the largest in the EEZ with a TACC of 7,000 t (2009–10).

The Chatham Rise smooth oreo stock was last assessed in 2007. The 2007 Plenary report states:

"The model estimates of mid-year mature biomass in 2005–06 was 57% (51–62) of mature B_0 and suggests that there is not an immediate sustainability issue with this stock. However, there are considerable uncertainties associated with this assessment described in section 4.3 (f) above. The main uncertainty is that substantial proportions of the abundance in each acoustic survey are attributed to layer marks which are generally not fished by the commercial fishery. Also, standardised CPUE in the larger east fishery has declined in recent years."

In November 2009 another acoustic survey of smooth oreo in OEO 4 was completed to extend the time series which started in 1998.

Objective 1

Standardised CPUE will be updated with the inclusion of data up to 2009/10.

Objective 2

It is proposed to update the stock assessment for the Chatham Rise smooth oreo fishery (OEO 4) using the new biomass estimate from the November 2009 acoustic survey (project OEO2009/02) and standardised CPUE analysis (from Objective 1 of this project). The assessment also uses data from the Observer Programme on the length distribution of the catches to estimate the selectivity pattern of the commercial fishery.

Frequency

This project is scheduled to be repeated in 2013–2014, 2016–2017 and 2019–2020.

Project: Stock assessment of southern blue whiting (SBW6B)

Project Code: SBW2010/01

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To update the southern blue whiting stock assessment of the Bounty Platform including estimating biomass and sustainable yields.

Rationale

This fishery was developed in the early 1970s by the Soviet fleet. Landings have fluctuated considerably, peaking at 75,000 t in the 1991/92 fishing year, when almost 60,000 t was taken from the Bounty Platform stock. From 1992/93 to 1995/96 an annual catch limit of 32,000 t applied, but this was increased for the 1996/97 fishing year to 58,000 t, as the stock assessment indicated higher yields were available. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks in SBW6. TACCs have been set at the level of the estimated CAY in most stocks each year resulting in fluctuating total catch limits.

There is uncertainty over the estimates of current stock size for all four stocks. This is due to imprecision in the acoustic data and to uncertainty over recent and future recruitment. The fishery is strongly recruitment driven and is currently dependent on less than five year classes, compared with up to 15 year classes in the past.

Surveys carried out by the fishing industry in the last three fishing seasons indicate that there has been a very large increase in biomass in the Bounty stock since 2004. Catch-at-age data suggest that a strong year class (born in 2002) has recently entered the fishery. Estimates of the size of this year class and the current biomass are very uncertain but biomass is likely to be above 100,000 t.

Objective

The recruitment of the large (slow growing) 2002 year class has caused some difficulty with the stock assessment for the Bounty Platform stock. Modifications to the assessment model have been required to allow better fits to the catch at age data coming from the fishery and the abundance indices from the acoustic surveys. From the 2010 fishing season, another year of catch at age data will be available (project MID2010/01) and a further acoustic survey will be completed from an industry vessel.

Frequency

This project is scheduled to be delivered annually.

Project: Stock assessment of southern blue whiting (SBW6R)

Project Code: SBW2010/05

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To carry out stock assessments of southern blue whiting (*Micromesistius australis*) including estimating biomass and sustainable yields.

Rationale

The southern blue whiting fishery was developed in the early 1970s by the Soviet fleet. Landings have fluctuated considerably, peaking at 75,000 t in the 1991/92 fishing year. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks in SBW6 (5,500 t for Pukaki Rise). On the Pukaki Rise fishing grounds, the catch limits have generally been under-caught in most years since their introduction. This reflects the relatively low economic value of the fish and difficulties in both the timing and locating of aggregations experienced by operators.

Large aggregations of spawning SBW were detected by vessels fishing on the Pukaki Rise in 2009, and 10 vessels caught nearly 5,000 t. Three vessels opportunistically collected acoustic data on these aggregations. The acoustic biomass estimates for the two daytime snapshots at the Pukaki Rise in 2009 were 26,000 t (c.v. 29%) and 17,000 t (c.v. 41%), which is of a similar magnitude to the abundance of 4+ SBW estimated from previous wide-area acoustic surveys of the area. Catch at age data are available from 2009 and suggest the catch is dominated by relatively young fish from the 2003–2006 year classes.

Objective

The last assessment of the Pukaki Rise was completed in 2002. Since then, considerable data have been collected including catch-at-age, acoustic indices, and trawl survey indices which will allow the assessment to be updated. Catch-at-age data are available for the period 1989 to 2000 and again for 2007 and 2009, although the numbers of fish measured and aged are low in some years. The catch is currently dominated by two main modes: a mode of larger fish comprising the 2003–2005 year classes and a mode of smaller fish at about 30 cm which are 3 year olds of the 2006 year class.

The previous assessment used a time series of acoustic biomass estimates from 1993 to 2000. The Working Group did not accept the high value of acoustic q (2.7) estimated by the model and believed this value was outside the credible range. Assuming a value of 1.4 for q resulted in estimates of 22,000 t for B_0 and 13,000 t for biomass in 2000.

The stock assessment will be updated in 2011 using catch at age data from the fishery, further acoustic data from industry vessels (up to 2010, if available) and indices from the series of Sub-Antarctic trawl surveys up to December 2010.

Frequency

This project is scheduled to be repeated in 2012–13, 2014–15, 2016–2017 and 2018–19.

Project: Bycatch monitoring and quantification of deepwater stocks (Year 1–scampi)

Project Code: DAE2010/02

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To estimate the level of non-target fish catch and discards of target and non-target fish species in the New Zealand bottom trawl fishery for scampi.

Specific Objectives:

1. To estimate the quantity of non-target fish species caught, and the target and non-target fish species discarded, in the trawl fisheries for scampi for the fishing years 2006/07 to 2009/10 using data from MFish Observers and commercial fishing returns.

2. To compare estimated rates and amounts of bycatch and discards from this study with previous projects on bycatch in the scampi fishery.

3. To compare any trends apparent in bycatch rates in the scampi fishery with relevant fishery independent trawl surveys.

Rationale

General

Management objective MO2.4 of the draft deepwater fisheries plan is "*Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on incidental bycatch species*". This project continues a rolling programme to review discard and non-target fish catch in major target fisheries. Fishing activities normally target a limited number of commercial species. However, other fish species are also taken and some may be processed as bycatch products. Unwanted fish, whether target or non-target, are often discarded if they are damaged, of an unmarketable size, or, for other reasons, have no commercial value. Previous reviews of scampi trawl fisheries included data up to the 2005/06 fishing year. This project will update bycatch and discard rates to the 2009/10 fishing year.

The TCEPR reporting forms used by scampi fishers provide for only the top five species by weight to be reported, although they provide tow by tow information on fishing effort. MFish observers record tow by tow data on all species caught on observed tows, but only a relatively small proportion of tows are observed. The merging of these two data sets allows for estimation of fishery-wide bycatch and discards.

In common with most crustacean trawl fisheries worldwide, bycatch in the scampi fishery is higher than in finfish fisheries. A large number of QMS species are caught (including hoki, ling, sea perch, stargazer, gemfish, lookdown dory, and red cod), but, in many areas, a larger weight of non-QMS species is caught and, mostly, discarded. Some of these discarded species may have low productivity and are potentially vulnerable to over exploitation. This project will provide for monitoring of trends in discard rates for scampi and other QMS species (for potential use in stock assessment modelling), and catch and discard rates for a wide variety of non-target species (for use in monitoring and risk assessments for non-QMS species).

Objective 1

This objective will provide for a desktop exercise using data already available in MFish databases of commercial catch and effort (TCEPR and CLR forms) and observer records.

Objective 2

Projects ENV2001/04 and ENV2007/02 considered bycatch in the scampi trawl fishery. This objective will provide for a comparison of recent rates of bycatch and discarding with these previous estimates and for an assessment of trends in rates or amounts. If the modelling approach or model outputs from this study cannot be readily compared with previous studies, it may be necessary to model the whole time series.

Objective 3

Trends in bycatch rates for non-QMS fish in the scampi fishery could be a result of changes in fishing practice or changes in relative abundance (or both). This objective will provide for a comparison of any trends with relevant data from fishery independent surveys that might be used to better understand the underlying causes of changes in fishery bycatch.

Frequency

This project is scheduled for annual delivery although the fishery under review will change each year as follows:

Year	Species
2011 - 2012	SQU
2012 - 2013	LIN (Bottom longline)
2013 - 2014	HOK / HAK/ LIN
2014 - 2015	JMA
2015 - 2016	SBW
2016 - 2017	ORH / OEO
2017 - 2018	SCI
2018 - 2019	SQU
2019 - 2020	LIN (Bottom longline)

Project: Ecological risk assessment for deepwater stocks

Project Code: DAE2010/03

Start Date: Current year

Completion Date: 30 June 2016

Vessel Use: None

Overall Objective:

1. To assess the ecological risks posed by deepwater fishing activities for ORH, OEO, CDL, and BYX.

Specific Objective:

1. To implement an ecological risk assessment, ERA, for deepwater fishing activities for ORH, OEO, CDL, and BYX using the methodology developed in project DEE2010/04.

2. To implement an ecological risk assessment, ERA, for deepwater fishing activities for SQU and SCI using the methodology developed in project DEE2010/04.

3. To implement an ecological risk assessment, ERA, for deepwater fishing activities for JMA and SBW using the methodology developed in project DEE2010/04.

Rationale

Seven management objectives related to the Environment Outcome are specified in the draft National Deepwater Plan:

MO2.1 *Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy*
MO2.2 *Maintain the genetic diversity of deepwater and middle-depth target and bycatch stocks*
MO2.3 *Protect habitats of particular significance for fisheries management*
MO2.4 *Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on incidental bycatch species*
MO2.5 *Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long term viability of protected, endangered and threatened species*
MO2.6 *Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on biological diversity*
MO2.7 *Identify and avoid or minimise adverse effects of deepwater fishing activity on the benthic habitat.*

Assessing the extent to which management action is required to meet these objectives will require knowledge and assessment of the risks in each case. A wide variety of risk assessment approaches is available, from qualitative expert opinion to fully quantitative modelling, and project DEE2010/04 will explore these to determine the most appropriate for the range of environmental and ecosystem issues potentially associated with deepwater fisheries.

Objective 1

A preferred approach to ecological risk assessment (ERA) will be developed under project DEE2010/04 and this project provides for that approach to be implemented for the main deepwater stocks of orange roughy, oreos, cardinalfish, and alfonsino. The risk assessment will be one input to risk management which will be implemented through the fisheries planning process.

Frequency

A delivery schedule for all ecological risk assessments included in the 10 Year Research Plan, and the species involved, is described in the table below.

Year	Species
2012–2013	Squid and scampi
2015–2016	Jack mackerel and southern blue whiting
2017–2018	Hoki, hake and ling
2019–2020	Orange roughy, oreo, cardinalfish and alfonsino

Project: Monitoring the trawl footprint for deepwater fisheries

Project Code: DAE2010/04

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To monitor the "footprint" of bottom contacting trawl fishing for deepwater and middle-depth species.

Specific Objectives:

1. To estimate the 2009/10 trawl footprint and map the spatial and temporal distribution of bottom contact trawling throughout the EEZ between 1989/90 and 2009/10.

2. To produce summary statistics, for major deepwater fisheries and the aggregate of all deepwater fisheries, of the spatial extent and frequency of fishing by year, by depth zone, by fishable area, and by habitat class, and to identify any trends or changes.

Rationale

An environmental standard for managing impacts on benthic habitats is under development by the Ministry of Fisheries, although the structure and focus of the standard is not yet known. Until the precise nature of the standard is known, it has been a working hypothesis that some sort of spatial approach will be a component. This led to the development of management objective MO2.7 of the draft deepwater fisheries plan, to "*Manage effects from the impact of deepwater fishing activity on the benthic habitat using a spatial management approach*". This project will provide for spatial description and monitoring of the areas used for bottom trawling.

Objective 1

This objective will provide for mapping of the areas where bottom contacting trawls (whether reported as bottom trawls or midwater trawls) were used in each year since the 2005/06 fishing year (i.e., since the last EEZ-wide review under project BEN2006/01). These maps should be combined with those from BEN2006/01 to estimate the cumulative footprint of all bottom contacting trawling since 1989/90. This analysis should be restricted to vessels fishing for those deepwater stocks included in the draft deepwater fisheries plan or to the relevant groups of target species agreed to by the Aquatic Environment Working Group for project BEN2006/01. Separate maps should be produced for the most recent fishing year, 2009/10.

Objective 2

Using the maps and information generated in Objective 1 and other information as necessary, summary statistics should be developed that can be used to describe trends in the fisheries and, potentially, to assess performance against a spatially-based standard (a benthic impact standard is under development by the Ministry of Fisheries at the time of writing but the precise nature and information requirements of that standard are not yet known). Summary statistics must include, for particular fisheries or groups of target species (e.g., those groups agreed to by the Aquatic Environment Working Group for project BEN2006/01) and for the aggregate of all fisheries included in the draft deepwater fisheries plan:

- The total number of bottom contacting trawls and the total spatial area affected ("footprint") each year
- The total number of bottom contacting trawls and the footprint over all years
- The spatial area affected by depth zone, by fishable area, and by habitat class
- The spatial area affected in relation to the preferred habitat of key target species
- The nature and extent of trawling for deepwater stocks relative to any agreed or developing environmental standard

Given the fluid situation with respect to environmental standards, discussions with Ministry of Fisheries science, fisheries management, and standards staff will probably be required to finalise the summary statistics to be calculated under this objective and the precise definitions of "fishable area", "habitat class", and "preferred habitat" to be used. Any trends in the summary statistics or maps of trawl effort over time should be identified and, to the extent possible, explained.

Frequency

This project is scheduled for annual delivery.

Project: Estimating the nature and extent of incidental captures of seabirds, marine mammals and turtles in New Zealand commercial fisheries

Project Code: PRO2010/01

Start Date: Current year

Completion Date: 31 July 2013

Vessel Use: None

Overall Objectives:

1. To estimate the nature and extent of captures of seabirds, marine mammals and turtles, and the warp strikes of seabirds in New Zealand fisheries (deepwater, highly migratory and inshore) for the fishing years 2009/10, 2010/11 and 2011/12.

Note: This project is not limited to environmental interactions in deepwater fisheries only but will require an assessment of the nature and extent of incidental captures of endangered threatened and protected species across all New Zealand commercial fisheries. Research providers must factor this requirement into their research proposal.

Specific Objectives:

1. Estimate capture rates per unit effort and total captures of seabirds, marine mammals and turtles in selected fisheries by method, area, and target fishery, and where possible, by species for the fishing years 2009/10, 2010/11 and 2011/12.

2. Examine the incidence of seabird warp strike in trawl fisheries where these data are available from fisheries observers, and estimate the rate of incidents (birds affected per hour) and total number of seabirds affected. Examine the factors (fishery, environmental, seasonal, area) that influence the probability of warp-strike occurring.

Rationale

Application to management

New Zealand has responsibility under the Fisheries Act 1996 and a variety of policy statements and international agreements to avoid, remedy or mitigate any adverse effects of fishing on the Aquatic Environment. This includes monitoring the nature and extent of fishing interactions with the marine environment.

To assess the success of New Zealand fisheries at avoiding, remedying or mitigating the effects of fishing activity on the marine environment, it is necessary to examine the capture statistics for seabirds, marine mammals and turtles caught on New Zealand fishing vessels. In this project, the total captures and capture rates of seabirds, marine mammals and turtles, caught in New Zealand fisheries will be estimated. Where possible, species level

captures will be estimated, although it is recognised this may be possible for only a small number of the species captured. The aim of this work is to provide:

- Measures of performance for different fishery method-area groups, through the monitoring of catch rates and total captures on a fishery-by-fishery basis

- Measures of the relative effects of fishing on seabird, marine mammal and turtle populations at risk from fisheries mortalities through enumeration of the total captures of seabirds, marine mammals and turtles in fisheries sampled. Although it is recognised that measures of mortality for a particular population of seabirds, marine mammals and turtles are not possible to derive given the level of observer coverage across New Zealand fisheries for most species, relative importance of different fisheries in contribution to incidental catch levels will allow definition of the risk posed to seabird populations from particular fisheries methods, in relation to the species captured

Objective 1

The project will report the capture rates and total captures of seabirds, marine mammals and turtles for fisheries by method-area stratum, and in relation to the target species of the fishery. Fishing effort and rates of observer coverage by effort will be reported. The research should cover all fisheries where observer data are available, or area and method stratum where it is reasonable to make inference about seabirds, marine mammals and turtles catch statistics, based on observations in fisheries with similar characteristics. Where possible, species level capture estimates will be produced.

A statistical comparison with previously reported rates is required, to allow an examination of the trends in seabird, marine mammal and turtle captures through time. This should be done in relation to any documented changes in fishing practices (e.g. through implementation of Codes of Practice or regulations) and in relation to changes in fishing effort or fleet composition. The report should contain summary tables that indicate catch rates and total captures for seabirds, marine mammals and turtles for the last 5 years, and analyses will allow statistical comparison of catch rates or total captures between these estimates to be discussed. Model-based analyses are expected for this research. A technical group should review model selection and data inputs to models during the course of the work. Where the data do not support this approach for particular fisheries, other methods may be used. Comparison of results from the different estimation methods across all fisheries where modelling techniques are applied should be undertaken. The report should clearly set out the preferred methodology that minimises variance and provides most accurate estimates of seabird captures.

The analyses should be conducted using estimation procedures similar to those developed during projects ENV2004-04, ENV2005-01, ENV2005-02, PRO2006-04, PRO2006-05, PRO2007-01 and PRO2007-02, where possible using model-based predictive approaches to examining seabird-capture rates and total capture estimates. Thresholds for an acceptable level of credibility of estimates should be defined. The analyses will report the different species caught, number retained and released alive by area, season and target fishery and

provide an assessment of the fisheries method and area strata that engender the greatest risk to particular seabird species or populations. Total captures for the New Zealand region shall be described. The research should examine the representativeness of observer data in relation to fishing effort by season and area, and by vessel type (e.g. processing type, size or power, mitigation used). Recommendations on improved sampling design for observer-gathered datasets will be required, in relation to the deployment of observer effort across fisheries.

Seabird, marine mammal and turtle capture information from fisher-submitted Non-fish/Protected Species Catch Returns shall be reported, where available, in the same strata as are used for the observer-derived estimates of capture to allow a comparison of information. It is recognised that the reporting format has been revised recently, which should have resulted in improved data availability.

Particular attention should be directed to the observer data from fisheries that have poorly understood levels of interactions with protected species. These are likely to include those fisheries that have recently been observed or are sporadically observed. Capture rates and extrapolations to total levels of protected species bycatch are ideal results from these analyses, however these may need to be considered at smaller scales at which observer coverage is more robust (i.e. at FMA or statistical area level). The research should report information noted by fisheries observers and fishers that may provide insight into particular capture events or fishing practices that could be related to successfully allow avoidance of seabird captures (or fishing practices that are associated with high numbers of seabird captures). Using these different sources of information, an assessment will be made of the performance of different fishery strata (by method, area, and where possible target species) in avoiding, remedying, or mitigating the effects of fishing-related mortality, where information is sufficient to make this assessment.

Objective 2

Seabird warp strikes in trawl fisheries have been quantified and examined following observations predominantly in the squid trawl fishery (Abraham 2006, Abraham & Kennedy 2008, Abraham & Thompson 2009) and in experimental trials of warp-mitigation devices (Middleton & Abraham 2007). This study showed that there were significant relationships between a number of fishing practices (offal dumping, discharge of fisheries waste, use of mitigation deterrents) and the occurrence of seabird warp-strikes, with differences in the factors for small and large seabirds.

Data are being collected using the seabird warp strike protocol by MFish observers during fishing trips throughout a range of middle-depths and deep-water trawl fisheries. The objective of this work is to analyse these data, and examine the probability of warp strike occurrence in relation to:

- Season, area and target species fished
- Fishing method and vessel type / size
- Bycatch reduction techniques used
- Meal plant usage

- Discharge of fisheries waste and offal
- Environmental factors such as sea state, wind direction, swell
- Abundance of birds behind the vessel
- Number of birds landed on the vessel for the fishing event

Building on previous work (by Abraham 2006, Abraham & Kennedy 2008, Abraham & Thompson 2009) and analyses associated with experimental trials during 2005/06 (Middleton & Abraham 2007), the research will examine which factors affect the probability of warp strike occurring in a range of trawl fisheries, with separate analyses required for small and large birds as appropriate. Additional factors to be considered should include examining variation between vessels and observers. Interaction terms should be explored. Data grooming protocols should be documented. A technical group should review model selection and data inputs to models during the course of the work. The work will report the rates of warp strike across the set of fisheries for which there are data and factors associated with high or low warp-strike occurrence.

Frequency

This project is currently scheduled for annual delivery. Research in future years may be required to incorporate the findings of research project DEE2010/03 on assessing cryptic mortalities from the effects of fishing.

Project: Develop and test a methodology to estimate cryptic mortality of endangered, threatened and protected species from deepwater fishing activity

Project Code: DEE2010/03

Start Date: Current year

Completion Date: 30 September 2012

Vessel Use: Subject to tender

Overall Objective:

1. To develop and test one or more approaches to estimating cryptic mortality of endangered, threatened and protected species caused by deepwater fishing activities.

Specific Objectives:

1. To conduct a review of existing national and international techniques to estimate cryptic mortality of endangered, threatened and protected species caused by deepwater fishing activities.

2. To develop one or more approaches to estimating cryptic mortality of endangered, threatened and protected species caused by deepwater fishing activities.

3. To field test one or more approaches to estimating cryptic mortality of endangered, threatened and protected species caused by deepwater fishing activities.

Rationale

Management objective 2.5 in the draft deepwater fisheries plan is "*to manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long term viability of protected, endangered and threatened species"*. An environmental standard for managing impacts on seabirds is under development by the Ministry of Fisheries, and other protected species have been highlighted for future standards. The structure and focus of these standards are not yet known and it is not possible to prescribe the specific information requirements for each. However, research to date has shown that cryptic, un-observed (and in some cases unobservable) mortality can be a substantial source of uncertainty when assessing the extent to which fishing-related mortality is likely to have an adverse effect on the long term viability of protected, endangered and threatened species. It is therefore important to develop methods of assessing cryptic mortality in a variety of situations so that total fishing-related mortality can be estimated.

Objective 1

This objective will provide for the review of techniques previously applied within New Zealand and internationally to assess the cryptic mortality of endangered, threatened and protected species from fishing activity of the same nature as New Zealand's deepwater fishing activities. This review will provide the basis for developing robust approaches given learning from other approaches or attempts to test approaches in the field.

Objective 2

This objective will provide for the design of experimental or other approaches to estimating the level of cryptic mortality of endangered, threatened, or protected species caused by fishing activity. Examples include the level of mortality caused by heavy collisions between seabirds and trawl warps (also known as warp strikes), and the proportion of drowned seabirds that fall from set nets or longlines before the gear is recovered. It may be possible to use proxies to assess the extent of cryptic mortality, e.g. to assess the likelihood and severity of injury from warp strikes using biomechanical modelling. Approaches should be developed for all interactions with endangered, threatened, or protected species where cryptic mortality may be a non-trivial proportion of total mortality.

Objective 3

This objective will provide for the field (or practical) testing of experimental or other approaches to estimating the level of cryptic mortality of endangered, threatened, and protected species caused by fishing activity. At least one approach to estimating cryptic mortality should be field tested. Preferably this would include a formal assessment of cryptic mortality in a particular context (e.g., an assessment of the total number of seabird deaths caused by warp strikes in a particular fishery over a particular period) but, if the approach is entirely new, the work could be restricted, through consultation with the Ministry of Fisheries science and fisheries management staff, to a "proof of concept" trial.

Frequency

This is scheduled for delivery in 2010-2011 only.

Project: Development of a methodology for Ecological Risk Assessments for deepwater fisheries

Project Code: DEE2010/04

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To identify and develop a generic approach to Ecological Risk Assessment (ERA) of deepwater fisheries covered in the Deepwater Fishery Plan.

Specific Objectives:

1. To review approaches to Ecological Risk Assessments (ERA) and methods available for deepwater fisheries both QMS and non-QMS.

2. To develop and recommend a generic method for ERA in deepwater fisheries by using or modifying methods identified in Objective 1.

3. If a generic approach is not possible, to develop a nested approach that shares a core approach, but allows flexibility for tailoring methods for different fishery groupings.

Rationale

The Ministry of Fisheries draft Deepwater Fisheries Plan specifies seven environmental management objectives to meet the Environmental Outcome specified in Fisheries 2030:

MO1.1 *Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy*
MO1.2 *Maintain the genetic diversity of deepwater and middle-depth target and bycatch stocks*
MO2.3 *Protect habitats of particular significance for fisheries management*
MO2.4 *Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on incidental bycatch species*
MO2.5 *Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long term viability of protected, endangered and threatened species*
MO2.6 *Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on biological diversity*
MO2.7 *Identify and avoid or minimise adverse effects of deepwater fishing activity on the benthic habitat.*

To meet these Management Objectives (in particular MO2.4–MO2.7), fisheries managers have determined that ERAs will be required for fisheries or groups of fisheries in the Deepwater Fisheries Plan.

Ecological risk assessment is a process that evaluates the likelihood that particular ecological effects may occur, or are occurring, as a result of exposure to one or more impacts, such as fishing. The assessment begins with the identification of the threats and is followed by an assessment of the impacts of each threat. A wide range of environmental risk assessment methods is available and those applicable in particular circumstances are framed by the cost, the information available, and the questions being asked (including the seriousness of the risks). Small-scale or data-poor fisheries rely primarily on qualitative risk assessments and expert opinion (e.g., the Australian/New Zealand Standard for Risk Assessment, Australian / New Zealand Standards 1999), whereas larger, data-rich fisheries or more serious risks can be assessed using semi-quantitative or fully quantitative methods (e.g. "fuzzy logic" Cheung et al. 2004, "qualitative modelling", Dambacher et al. 2003; "Sensitivity model specific to seabed habitat and fishing" Hiddink et al. 2007, Hobday et al. 2007, or complex management strategy evaluations).

Several Ministry of Fisheries projects have reviewed or explored risk assessment approaches to ETP species (e.g., Waugh et al 2010, Sharp et al. 2009). Rowden et al. (2008) reviewed four possible ERA methods suitable for evaluating risks to seamount habitats and Clark et al (in press) applied the Australian ERAEF to seamount type features on the Chatham Rise. Several other impact and risk assessments have been completed in New Zealand (e.g., for Antarctic fisheries, Sharp et al., 2009 and for South Pacific high seas fisheries, Parker 2008).

Ideally, a generic approach to ERA in deepwater fisheries to facilitate comparability across fisheries and assist fishery managers in prioritising the response required to mitigate risk across fisheries should be developed. The ERA will be used to prioritise information collection and research and will contribute to the prioritisation of standards development. As already recognised by the tiered approach to species groupings in the Deepwater Fisheries Plan, data availability varies significantly among fisheries. This project seeks to review the available ERA methods and determine which are appropriate for the range of environmental and ecosystem issues potentially associated with deepwater fisheries.

Objective 1

This objective will build on existing reviews of ERA methods already conducted worldwide and provide a formal review and assessment of their utility for use in a deepwater fisheries context. One of the first steps may be to hold a workshop with MFish to explore the nature and extent of ERAs required for deepwater fisheries. Many approaches are available worldwide, and the workshop will ensure that we are focussed on methods that will meet the management needs. Potentially applicable methods should be documented along with their data requirements, management inputs, and the advantages and disadvantages of each. The final report should also indicate the information currently available for each fishery.

Objective 2

This objective builds on Objective 1, and assesses the feasibility and utility of developing a single generic ERA method for New Zealand deepwater and middle depth fisheries. This is the preferred outcome, and specific recommendations on a method should be developed.

Objective 3

If a 'one size fits all' approach is not possible, a nested or stepped approach should be explored, identifying core methods that are available and common to all deepwater fisheries, and identifying which methods are most appropriate to each fishery or groupings of fisheries. For example, fisheries may be classed by the level of information available or the type of fishery (e.g. depth of fishing, habitat types fished and so on).

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Frequency

This project is scheduled for annual delivery.

Project: Development of a suite of ecosystem and environmental indicators for deepwater fisheries

Project Code: DEE2010/05

Start Date: Current year

Completion Date: 30 September 2011

Vessel Use: None

Overall Objective:

1. To develop a suite of ecosystem and environmental indicators suitable for monitoring the environmental performance of deepwater fisheries within an environmental context.

Specific Objectives:

1. To review the literature and hold a workshop to recommend a suite of ecosystem and environmental indicators that will contribute to assessing the performance of deepwater fisheries within an environmental context.

2. To examine available data and design a data collection programme to enable future calculation of the indicators identified in specific objective 1.

Rationale

The Ministry of Fisheries Strategy for Managing the Environmental Effects of Fisheries (SMEEF) and the subsequent Fisheries 2030 document have both endorsed standards and indicators as ways of assessing the performance of fisheries. Indicators may reflect fisheries extractions or some state of the environment e.g. biodiversity, but these responses may be driven by either fisheries or environmentally-based causes. Monitoring of indicators related to fisheries performance, e.g. bycatch or benthic impacts, therefore needs to be considered within the broader environmental context.

The draft Deepwater Fisheries Plan has a number of environmental objectives that could be monitored using indicators, particularly:

MO 2.3 *Protect habitats of particular significance for fisheries management*
MO 2.4 *Identify and avoid or minimise adverse effects of deepwater and middle depth-fisheries on incidental bycatch species*
MO 2.6 *Manage deepwater and middle-depths fisheries to avoid or minimise adverse effects on biological diversity*
MO 2.7 *Manage effects from the impact of deepwater fishing activity on the benthic habitat using a spatial management approach*

Monitoring system-wide status and performance will however, require meaningful indicators that span all objectives if managers and stakeholders are to be forewarned of shifts that may entail changes or reductions in ecosystem services, e.g., a climatic regime shift that may decrease fisheries production. This will require the development, calculation, and monitoring of quantitative indicators, and comparison with appropriate reference points and standards when available.

Good ecosystem indicators should be easily measured, cost effective to collect and calculate, easily interpreted (to avoid confusion about the state of the system they are reflecting) and directly applicable to management targets. Many reviews of such indicators have been conducted (Landres, 1992; Rapport, 1992; Jackson et al., 2000; ICES, 2001; Tegler et al., 2001; Rochet & Trenkel, 2003; Rice & Rochet, 2004; Rochet & Rice, 2004; Cury & Christensen, 2005, and ICES Journal of Marine Science Volume 62, 2005), and there is some consensus that developing a suite of indicators is a better approach than relying on a single indicator to summarise an ecosystem. Some types of indicators have been found to be sensitive to data quality and quantity, local expertise, or system type, whereas others perform well in a range of circumstances. These more robust indicators include: trends in relative biomass (of groups such as gelatinous zooplankton, cephalopods, small pelagics, scavengers, demersal fish, piscivores, top predators, etc); biomass ratios (e.g., piscivore–planktivore or pelagic–demersal); size spectra; mean or maximum length in the catch; total fisheries removals (including bycatch, discards, and cryptic mortality); and the diversity or species richness of the catch.

Environmental indicators (i.e., physico-chemical rather than biological measures) are desirable as context for ecosystem indicators and to assist in teasing out possible causes for patterns in ecosystem indicators. It may be possible for observers or fishers to collect some environmental measures in a calibrated way or cheaply accessed (e.g. remote sensing). These could include calibrated measures of sea surface temperature in order to ground-truth remote sensed measurements or deployment of Expendable Bathythermographs (XBT).

A number of recent studies have already investigated environmental and ecosystem indicators in a New Zealand marine context. Fish-based ecosystem indicators derived from research trawl surveys were examined and those based on species diversity recommended as the most useful (Tuck et al. 2009). Fish stock indices were correlated with environmental or climate indices and significant correlations were identified for a number of stocks (Dunn et al. 2009). Climate and oceanographic trends relevant to New Zealand fisheries have been identified (Hurst et al. in press). Remote sensing and fisheries data have also been investigated for their potential to provide useful environmental indicators (Pinkerton 2010).

Objective 1

This objective will provide a desktop review of available ecosystem and environmental indicators and select a suite of indicators that meets the following criteria:

- The information required for each indicator is already collected remotely, through catch and effort returns, by observers, or otherwise, or can be collected at low marginal cost

- The entire suite provides some information on all aspects of ecosystem dynamics that could be affected by fishing or could affect fisheries productivity
- The properties and performance of individual indicators in different circumstances are broadly known
- The suite of indicators can be readily communicated to and understood by fisheries managers and stakeholders

This project should include an explicit review of the use of observers for collecting ecosystem and environmental data given the proposed increase in deepwater fisheries observer coverage; substantially more or different information could be collected if this would provide for better monitoring capability. A workshop should be held as part of this objective to identify possible indicators and their feasibility. The workshop should include a wide variety of stakeholders including, at a minimum, fisheries observer officers, scientists, industry representatives and managers.

Objective 2

Examination of existing data, e.g., observer records, should occur in order to evaluate the feasibility of using data collected under existing protocols for the generation of indicators. For indicators that cannot currently be calculated, a data collection programme should be designed and documented. This programme could include information to be collected by any combination of observers, fishers, and researchers, but should focus on information that can be collected simply and at low marginal cost. Any proposal for additional high cost research will need strong justification.

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Frequency

This is scheduled for delivery in 2010-2011 only.

Project: Design a programme to monitor trends in deepwater benthic communities

Project Code: DEE2010/06

Start Date: Current year

Completion Date: 30 September 2012

Vessel Use: None

Overall Objective:

1. To design and provide indicative costs for a programme to monitor trends in deepwater benthic habitats and communities.

Rationale

Management objectives 2.6 and 2.7 in the draft deepwater fisheries plan are "*to … avoid or minimise adverse effects on biological diversity"* and "*to manage effects from the impact of deepwater fishing activity on the benthic habitat*". Project DAE2010/04 provides for assessment and monitoring of the trawl "footprint", but there is potential to collect additional information to monitor benthic habitats and biodiversity inside and outside of the trawl footprint at relatively low marginal cost. Depending on the likely utility and cost, this information could form part of the suite of environmental indicators considered under project DEE2010/05.

Objective

This objective will provide for a desktop analysis of the extent to which a monitoring programme "tagged on" to existing surveys is likely to provide useful and cost-effective information on trends in benthic systems inside and outside of the trawl footprint and closures. Existing information should be explored to estimate the level of sampling that would be required to provide monitoring capability and the statistical power to detect specified changes in particular attributes given a particular design approach. These attributes could be quite diverse (e.g., the density of important structure-forming taxa, the diversity of readily observed epifauna or benthic fish, the estimated total abundance of all macrofauna over a given size, etc.), but the suite of attributes chosen (i.e., the "response variables" of the monitoring programme) should be developed iteratively from the analysis and through discussion with Ministry of Fisheries science and fisheries management staff and presentations to the Aquatic Environment Working Group. It is envisaged that this project would start with a scoping exercise to describe the data currently available on benthic habitats in the EEZ, an assessment of what attributes or indices could realistically be measured and monitored, and then proceed through a process of designing and costing the more promising opportunities.

The approximate marginal cost of the work necessary to undertake the more promising monitoring programmes should be assessed based on how the chosen sampling design could

be implemented alongside the existing objectives of other surveys, fieldwork, or from ships of opportunity. For instance, a trawl survey focussed on estimating relative biomass of a fishstock may provide opportunities for benthic sampling at times when trawling was not possible or appropriate, or during additional days added to the end of the biomass survey. Whatever the approach, the likely costs of sample collection, archiving, and analysis should be estimated separately. It is axiomatic that these costs will be indicative and that the actual cost of implementing any monitoring programme will depend on details that cannot be entirely prescribed in advance.

Frequency

This is scheduled for delivery in 2010-2011 only.

Project: Design an abundance survey for jack mackerel (JMA7) and middle depth species on the west coast, North Island

Project Code: JMA2010/02

Start Date: Current year

Completion Date: 30 June 2011

Vessel Use: None

Overall Objective:

1. To design an abundance survey for jack mackerel (*Trachurus declivis*, *Trachurus novaezelandiae*, *Trachurus murphyi)* and other middle depth species on the west coast, North Island.

Note: The Middle Depths Fishery Assessment Working Group will discuss the timing and method to be used for surveying JMA7 at their next meeting on August 3.

Rationale

Three species of jack mackerel are managed together as JMA: *Trachurus declivis*, *T. novaezelandiae*, and *T. murphyi* (Peruvian jack mackerel). Jack mackerel are almost exclusively a target species on the west coast of the North and South Islands in JMA 7.

Stock assessments for jack mackerel are complicated by the reporting and management of three species under a single code. Preliminary stock assessments for *T. declivis* and *T. novaezealandiae* in JMA 7 were undertaken in 2007 based on data from a new Bayesian analysis for splitting the recorded commercial catch into *T. declivis*, *T. novaezealandiae*, and *T. murphyi* components. This analysis was used to derive a catch history and CPUE indices for the *T. declivis* fishery in JMA 7, which were incorporated along with a proportions-at-age series into the assessments.

The 2007 preliminary assessment for *T. declivis* did not indicate sustainability concerns with this component of JMA 7 at that time though there are uncertainties in the assessment relating to the catch histories and abundance indices.

Objective

This project will provide a design for the acoustic survey to be used in this project. Some amount of trawling is likely to be required to identify the species mix in the acoustic marks.

Frequency

This is scheduled for delivery in 2010-2011 only.

PROJECTS STARTING FROM 2011/2012

Project: Estimation of hoki and middle depth fish abundance on the West Coast South Island using combined trawl and acoustic surveys

Project Code: HOK2010/04

Start Date: 1 January 2011

Completion Date: 30 September 2014

Vessel Use: Subject to tender, July 2011, 2012, 2013

Overall Objectives:

1. To estimate relative abundance indices for hoki (*Macruronus novaezelandiae*), hake (*Merluccius australis*) and ling (*Genypterus blacodes*) off the west coast, South Island.

Specific Objectives:

1. To carry out combined trawl and acoustic surveys to obtain relative abundance indices for hoki, hake (HAK 7) and ling (LIN 7) on the WCSI.
2. To continue the time series of relative abundance indices of spawning hoki on the WCSI using acoustic surveys, with a target coefficient of variation (c.v.) of the estimate of 30 %.
3. To collect data for determining the age and size structure and reproductive biology of hoki, hake and ling.
4. To determine species composition of fish marks measured acoustically during the survey by target trawling.

Rationale

Hoki is New Zealand's largest fishery with a current TACC of 110,000 t. Although managed as a single stock, in the past hoki have been assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

Historically, the main fishery for hoki has operated from mid-July to late August on the west coast of the South Island (WCSI) and in Cook Strait where hoki aggregate to spawn. The WCSI is also an important fishing area for hake and ling, with reported landings of nearly 6000 t in HAK 7 and over 2000 t in LIN 7 in 2008–09. Currently there are no fisheries independent estimates of ling and hake abundance on the WCSI. An assessment for LIN 7WC was carried out based on trawl and longline CPUE, but there was a high level of uncertainty about the status of this stock. Similarly, HAK 7 has been assessed but with high uncertainty.

The 10-year Deepwater Research Plan proposes a new series of trawl and acoustic surveys of the WCSI to provide estimates of biomass for hoki, hake and ling. Three initial surveys will be carried out annually from 2011 to 2013 then the series will continue at 2 year intervals.

Previous acoustic surveys of the WCSI hoki spawning grounds were carried out in 1988–93, 1997, and 2000. However, there was much uncertainty over the abundance indices from the two most recent surveys of the WCSI because of species mix in the northern strata. Following a review of results from the 2000 survey, Francis & O'Driscoll (2004) proposed a combined trawl and acoustic survey as a practical approach to measuring hoki biomass more consistently. Simulation studies suggested that there would be a gain in information by switching from the previous method of producing one acoustic abundance index for the whole WCSI to a new method where three relative biomass estimates are produced – a northern acoustic index, a southern acoustic index, and a northern trawl index. Estimates based on information from the 2004 survey suggested that the gain from making this change would be equivalent to reducing a simple survey C.V. from 0.31 to 0.21.

The trawl component of a combined survey would also provide relative abundance estimates for other species in the northern area. Relatively precise (C.V. less than 25%) trawl estimates of abundance were obtained for hoki, ling, hake, silver warehou, and lookdown dory during the 2000 acoustic survey.

Objective 1

The trawl survey would cover the region north of Hokitika Canyon. Optimisation based on trawl catch rates from the WCSI suggest that about 50 random bottom trawls would be required in the northern area to achieve target CVs of 20% for hoki, hake, and ling. All bottom trawls should be carried out during the day when a greater proportion of fish are near the bottom and catch rates are higher.

Significant quantities of hake and ling also occur in Hokitika Canyon. It may be possible to collect trawl and acoustic data to estimate abundance in this region. Macaulay & Dunn (2000) suggested it was feasible to use acoustics to estimate hake biomass on the WCSI, and that an acoustic survey for hake could be combined with a hoki acoustic survey.

Objective 2

Acoustic measurement of hoki biomass from the WCSI will be compared to the earlier surveys carried out in 1988–93, 1997, and 2000.

Objective 3

Information on age structure and reproductive biology of hoki, hake, ling, and associated species will also be obtained during the survey. These data could be used to explore potential interactions between fishing and estimate reproductive success (fecundity, atresia) of hoki.

Objective 4

The major uncertainty in interpreting acoustic indices for hoki is determining species mix. It is proposed that both bottom and midwater trawling be completed during the acoustic survey to determine species composition, in addition to the trawl survey. Acoustic methods of discriminating between species should also be considered.

Frequency

This research project is scheduled to be delivered in 2011–2012 and will be repeated in 2012–2013, 2013–2014, 2015–2016, 2017–2018 and 2019–2020.

Project: Estimation of hoki and middle depth fish abundance on the Chatham Rise using trawl surveys

Project Code: HOK2010/05

Start Date: 1 January 2011

Completion Date: 30 September 2015

Vessel Use: Subject to tender, January 2012, 2013, 2015

Overall Objective:

1. To estimate the abundance of hoki (*Macruronus novaezelandiae*) and middle depth species on the Chatham Rise from trawl surveys.

Specific Objectives:

1. To continue the time series of relative abundance indices of recruited hoki (eastern stock) and other middle depth species on the Chatham Rise using trawl surveys and to determine the relative year class strengths of juvenile hoki (1, 2 and 3 year olds), with target c.v. of 20 % for the number of two year olds.

2. To determine the population proportions at age for hoki on the Chatham Rise.

3. To collect acoustic and related data during the trawl survey.

4. To sample deeper strata for orange roughy using a random trawl survey design.

5. To collect and preserve specimens of unidentified organisms taken during the trawl survey.

Rationale

Hoki is New Zealand's largest fishery with a current TACC of 110,000 t. Although managed as a single stock, in the past hoki have been assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

Because of the importance of the hoki fishery a trawl survey is carried out in January each year on the Chatham Rise to measure the abundance of both juvenile and adult hoki. Other middle depth species (particularly hake and ling) are also monitored by this survey time series. In January 2010 this survey was extended to sample deeper strata (800 to 1300 m) in the north and east Rise. The survey appeared to be useful for measuring abundance of orange roughy in both the Northwest and east and South Rise stocks but less useful for oreos, which are more widespread over the South Rise. Only 7 of the 10 deeper strata were surveyed in 2010 because of time constraints.

The hoki fishery is now strongly recruitment driven and therefore subject to large fluctuations in stock size. To manage the fishery and minimise potential risks, it is important to have some predictive ability concerning recruitment into the fishery.

Extensive sampling throughout the EEZ has shown that the Chatham Rise is the main nursery ground for hoki aged 2 to 4 years. Abundance estimation of 2+ hoki provides the best index of potential recruitment to the adult fisheries. The survey data from both juvenile and adult abundance is input into the model directly to estimate recruitment parameters and determine current stock status.

The continuation of the time series of trawl surveys on the Chatham Rise is a high priority to provide information required to update the assessment of hoki and other middle depth species. In the 10 Year Research Plan it is proposed to carry out the survey in 8 of the next 10 years.

Objective 1

Random trawl surveys at 200-800 m depths on the Chatham Rise have been carried out annually from January 1992 to 2010 to obtain relative biomass estimates of adult and juvenile hoki. Current information on juvenile hoki behaviour suggests that the 2+ cohort provides the best recruitment index. There is a time lag of about 3 years between surveys of the 2 year olds and their full recruitment into the adult fisheries.

Objective 2

Otolith samples will be collected throughout the survey strata. These will be aged to determine an age-length key, which can be used with the length frequency distribution of the hoki catches to determine the proportion at age of fish in the population. This will be used as inputs to the stock assessment for hoki. (Note: the ageing of the hoki otoliths will be completed under project MID2010/01).

Objective 3

In most previous surveys of the Chatham Rise acoustic recording has been carried out during each trawl and when steaming between stations to build up a baseline dataset of mark types in the area. It is unlikely that acoustics will provide an alternative biomass estimate for the Chatham Rise in the short term. However, these data provide information on the proportion of fish in midwater and help in interpretation of the trawl survey results. Data from previous surveys have been analysed to describe mark types, provide estimates of the ratio of acoustic vulnerability to trawl catchability for hoki and other species and to estimate biomass of mesopelagic fish.

Objective 4

The pilot survey in 2010 suggests that it is possible to extend this survey into deeper water at low marginal cost to measure orange roughy abundance on the Chatham Rise. Additional days will be required to cover the area of orange roughy distribution.

Objective 5

All catch taken during the trawl survey should be recorded at each station. Specimens of unidentified organisms should be sampled and preserved for future analysis and identification. This objective does not include the identification of these organisms, which will be completed under a separate project.

Frequency

This research project is scheduled to be delivered in 2011–2012 and will be repeated in every year **except** 2013–2014 and 2017–2018.

Project:	Estimation of hoki and middle depth fish abundance on the Southern Plateau using trawl surveys
Project Code:	MDT2010/02
Start Date:	1 January 2012
Completion Date:	30 June 2015
Vessel Use:	Subject to tender, December 2012, 2014

Overall Objective:

1. To continue a time series of relative abundance indices for hoki (*Macruronus novaezelandiae*), hake (*Merluccius australis*) and ling (*Genypterus blacodes*) in the Southland and Sub-Antarctic QMAs.

Specific Objectives:

1. To carry out trawl surveys in December 2012 and 2014 to continue the time series of relative abundance indices for hoki, hake (HAK 1) and ling (LIN 5 and 6) on the Southern Plateau.

2. To collect data for determining the population age and size structure and reproductive biology of hoki, hake and ling.

3. To determine the proportions at age of hoki taken in the survey.

4. To collect acoustic and related data during the trawl survey.

5. To collect and preserve specimens of unidentified organisms taken during the trawl survey.

Rationale

Hoki is New Zealand's largest fishery with a current TACC of 110,000 t. Although managed as a single stock, in the past hoki have been assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

Historically, the main fishery for hoki has operated from mid-July to late August on the west coast of the South Island (WCSI) and in Cook Strait where hoki aggregate to spawn. Largest catches were previously from the western stock, however, in recent years the fishery has been carried out all year on the Chatham Rise and catches from the eastern stock have increased. This is thought to present a higher risk to the smaller eastern stock. Industry has attempted to spread the catch to other areas of the fishery in recent years.

Ling and hake are important commercial species in the Southland and Sub-Antarctic QMAs (QMAs 5 and 6). The Southern Plateau is also important as the residence area for the hoki stock that spawns off the west coast of the South Island in winter.

The continuation of the time series of trawl surveys on the Southern Plateau is a high priority to provide information required to update the assessment of hoki and other middle depth species. In the 10-year Deepwater research plan it is proposed to carry out the survey every second year from 2010.

Objectives 1 & 2

Trawl surveys have been carried out in this area since 1991, initially targeting hoki but also for hake and ling. The timing of the survey has varied with the first series of surveys carried out in December from 1991-93. After a break from 1993 to 1996 further surveys took place in April 1996 and in April 1998. However, from 2000 to 2009 the survey was transferred to December. The change was made for two main reasons; uncertainty over recent assessment for hoki stocks and a concern that the hake age structure was not well represented by the small samples taken in the April surveys. The longer daylight hours in December allow more stations to be occupied than in April and therefore more hake samples are likely to be taken, which would improve the determination of the age structure for this species.

In the 10 Year Research Plan, it is proposed to monitor the hake and ling biomass in this area by carrying out trawl surveys. Information on age structure and reproductive biology is also obtained during the survey.

Objective 3

Otolith samples will be collected throughout the survey strata. These will be aged to determine an age-length key, which can be used with the length frequency distribution of the hoki catches to determine the proportion at age of fish in the population. This will be used as inputs to the stock assessment for hoki. (Note: the ageing of the hoki otoliths will be completed under project MID2010/01).

Objective 4

Throughout the survey an acoustic recording should be made during each trawl and when steaming between survey stations. The data collected will add to the baseline dataset of mark types on the Southern Plateau.

Objective 5

All catch taken during the trawl survey should be recorded at each station. Specimens of unidentified organisms should be sampled and preserved. Future analysis and identification will be undertaken under a separate research project.

Frequency

This research project is scheduled to be delivered in 2012–2013 and will be repeated in 2014–2015, 2016–2017 and 2018–2019.

Project: Estimation of the abundance of orange roughy using trawl surveys (ORH MEC stock)

Project Code: ORH2010/06

Start Date: 1 October 2013

Completion Date: 30 June 2015

Vessel Use: Subject to tender, April 2014, 2018

Overall Objective:

1. To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) for the Mid East Coast (MEC) stock.

Specific Objective:

1. To estimate the abundance of orange roughy for the Mid East Coast (MEC) stock, from a trawl survey with a target coefficient of variation (c.v.) of the estimate of 20-30 %.

Rationale

Spawning has been identified at Ritchie Bank but no large concentrations have been found in ORH 2B or 3A, and fish are believed to migrate from these areas to the Ritchie Bank to spawn. The Mid East Coast (MEC) is assessed as a separate stock from the other known ECNI spawning fishery at East Cape.

In the early 1980s the orange roughy fishery on the ECNI developed, starting initially in the Wairarapa area and extending north to Ritchie Bank and south to Kaikoura. Landings of MEC orange roughy peaked at 10,500 t in 1989-90 and were maintained for several years at this level before catch limits were reduced in the mid 1990s. The largest fishery took place in an area known as the Rockgarden (in ORH 2A South)) and also extended along the 1000m depth contour south to ORH 2B. The fishing down phase for this orange roughy stock was completed by the mid 1990s, by which time total reported landings exceeded 100,000 tonnes.

The MEC stock was assessed in 2004 and 2005, and it was concluded that biomass reached a minimum in the mid 1990s and appears to have been slowly increasing since. As a result of this assessment the catch limit was increased to 1,500 t from 1 October 2004.

The estimated current status of the stock is strongly dependent on how the CPUE data are treated in the model. Model projections indicate that stock size will increase at any catch level less than 3,000 t. However, these projections are very uncertain because the magnitude and rates of future increases in stock size are driven by the assumption that future recruitment will be constant at the virgin level. This observation is not supported by

any direct observations or data. Research surveys of the stock could provide fishery independent estimates of the current biomass.
Trawl surveys of the MEC stock across ORH 2A south, 2B and 3A have been carried out with the Tangaroa (1992–94 and again in 2010). Earlier surveys were in August-September and were extended to cover the whole stock area in 1989 (Will Watch). Random stations were chosen for the 1989 survey but these were repeated in later surveys. From 1992 the surveys were carried out in March-April with up to 220 stations per survey. Hill strata were added from 1992 to 1994 but little biomass was estimated in these strata. Smaller fish were generally found at Kaikoura with larger fish in the northern areas.

Another trawl survey abundance estimate obtained in March–April 2009 will allow the stock assessment to be updated during the stock assessment meetings in 2010.

Objective 1

The aim of this research project is to estimate the abundance of orange roughy in the MEC stock by trawl survey over ORH 2A south, 2B and 3A in March-April 2009. The target coefficient of variation (CV) is less than or equal to 20-30 %.

The 10-year Deepwater Research Plan has a programme of updating the biomass indices for each of the main orange roughy fisheries in the New Zealand EEZ every 3 to 5 years. Trawl surveys have been carried out for orange roughy for the MEC stock in the early 1990s and again in 2010. It is proposed to obtain further relative biomass estimates for the MEC at four year intervals using a trawl survey.

Frequency

This project is scheduled for delivery in 2013–14 and to be repeated in 2017–2018.

Project: Estimation of jack mackerel (JMA7) and middle depth fish abundance on the west coast, North Island

Project Code: JMA2010/01

Start Date: 1 October 2011

Completion Date: 30 June 2014

Vessel Use: Subject to tender, March 2012, 2013, 2015

Overall Objective:

1. To carry out a time series of relative abundance indices for jack mackerel (*Trachurus declivis*, *Trachurus novaezelandiae*, *Trachurus murphyi)* and other middle depth species on the west coast, North Island.

Specific Objectives:

1. To carry out a time series of acoustic surveys to measure relative abundance of jack mackerel species on the west coast, North Island.

2. To collect data for determining the population age and size structure of jack mackerel and other middle depth species.

3. To collect and preserve specimens of unidentified organisms taken during the trawl survey.

Rationale

Three species of jack mackerel are managed together as JMA: *Trachurus declivis*, *T. novaezelandiae*, and *T. murphyi* (Peruvian jack mackerel). Jack mackerel are almost exclusively a target species on the west coast of the North and South Islands in JMA 7.

Stock assessments for jack mackerel are complicated by the reporting and management of three species under a single code. Preliminary stock assessments for *T. declivis* and *T. novaezealandiae* in JMA 7 were undertaken in 2007 based on data from a new Bayesian analysis for splitting the recorded commercial catch into *T. declivis*, *T. novaezealandiae*, and *T. murphyi* components. This analysis was used to derive a catch history and CPUE indices for the *T. declivis* fishery in JMA 7, which were incorporated along with a proportions-at-age series into the assessments.

The 2007 preliminary assessment for *T. declivis* did not indicate sustainability concerns with this component of JMA 7 at that time though there are uncertainties in the assessment relating to the catch histories and abundance indices.

Objective 1

The project JMA2010/02 will provide a design for the acoustic survey to be used in this project. Some amount of trawling is likely to be required to identify the species mix in the acoustic marks.

Objective 2

Otolith samples will be collected throughout the survey strata. These will be aged to determine an age-length key, which can be used with the length frequency distribution of the jack mackerel and other species catches to determine the proportion at age of fish in the population. This will be used as inputs to the stock assessment. (Note: the ageing of all the otoliths will be completed under project MID2010/01)

Objective 3

All catch taken during the survey should be recorded at each station. Specimens of unidentified organisms should be sampled and preserved. Future analysis and identification will be undertaken under a separate research project.

Frequency

This research project is scheduled to be delivered in 2011–2012 and will be repeated in 2012–2013, 2014–2015, 2016–2017 and 2019–2020.

Project: Estimation of spawning hoki biomass using acoustic surveys (Cook Strait)

Project Code: HOK2010/03

Start Date: 01 January 2012

Completion Date: 30 June 2014

Vessel Use: Subject to tender, July-August 2012, 2014

Overall Objectives:

1. To estimate the spawning biomass of hoki (*Macruronus novaezelandiae*) using acoustic surveys.

Specific Objective:

1. To continue the time series of relative abundance indices of spawning hoki in Cook Strait using acoustic surveys, with a target coefficient of variation (c.v.) of the estimate of 30 %.

Rationale

Hoki is New Zealand's largest fishery with a TACC of 110,000 t since 1 October 2009. Although managed as a single stock, in the past hoki have been assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

Historically, the main fishery for hoki has operated from mid-July to late August on the west coast of the South Island (WCSI) and in Cook Strait where hoki aggregate to spawn. Largest catches were previously from the western stock, however, in recent years the fishery has been carried out all year on the Chatham Rise and catches from the eastern stock have increased. Industry has attempted to spread the catch to other areas of the fishery in recent years.

The 10-year Deepwater Research Plan proposes acoustic surveys of the Cook Strait hoki spawning grounds every two years to update the biomass indices. Although the acoustic results from Cook Strait have not been very influential on the results of the stock assessment model it is considered necessary to monitor the abundance of the eastern spawning stock independently of the Chatham Rise, where both eastern and western hoki are mixed together.

This project has high priority to continue the time series of biomass estimates for the eastern spawning stock in Cook Strait.

Objective 1

Previous acoustic surveys of Cook Strait were carried out on research vessels in 1991 and continuously from 1993-2006 (except 2000 and 2004). A further acoustic survey was

completed in winter 2008 (HOK2007/03) that also surveyed the east coast South Island areas of Pegasus and Conway trough. More recently industry vessels have surveyed part of Cook Strait during the hoki spawning season. A continuation of this approach is proposed here, where the main fishing grounds in Cook Strait would be surveyed throughout the spawning season from an industry vessel during commercial fishing trips.

It is proposed that both bottom and midwater trawling be completed during the acoustic survey to determine the relative abundance of hoki and other species. The abundance of the other species is required in order to estimate the biomass of hoki in the survey area.

Frequency

This research project is scheduled to be delivered in 2011–2012 and to be repeated in 2013–2014, 2015–2016, 2017–2018 and 2019–2020.

Project: Estimation of the abundance of smooth oreo in Southland (OEO1)

Project Code: OEO2010/02

Start Date: 1 January 2011

Completion Date: 30 June 2015

Vessel Use: Subject to tender, November 2011, 2014

Overall Objective:

1. To estimate the abundance of smooth oreo (*Psuedocyttus maculatus*) in Southland using acoustic survey with a target coefficient of variation (c.v.) of the estimate of 30 %.

Rationale

The Southland smooth oreo fishery is mostly in OEO 1 on the east coast South Island but catches in the northern end of the fishery straddle the boundary with OEO 3A at 46S. About 1000 t a year was taken from this fishery for many years but recent catches have been less than 300t per year (industry has adopted a voluntary limit of 400t). Oreos are managed as a species group, which includes commercial fisheries for black oreo (BOE) and smooth oreo (SSO), as well as non-commercial amounts of spiky oreo (SOR).

The 10-year Deepwater Research Plan has a programme of updating the biomass indices for each of the main oreo fisheries in the New Zealand EEZ every 3 to 5 years. Acoustic surveys have been carried out for smooth oreo in OEO 4, in 1998, 2001, 2005 and 2009, however, the Southland fishery has not been surveyed previously. Therefore, it is proposed to conduct a pilot survey to test the feasibility of estimating biomass for smooth oreo by acoustic survey.

Objective

Fishery independent surveys using acoustics may provide a means to measure the biomass of smooth oreo in this fishery. A pilot survey will be conducted in 2011 to look at the feasibility of carrying out the survey from a commercial vessel.

Frequency

This project is scheduled for delivery in 2011–12 and to be repeated in 2014–2015, 2017–2018 and 2019–2020.

Project: Estimation of the abundance of smooth oreo in OEO4 using acoustic surveys

Project Code: OEO2010/03

Start Date: 1 July 2012

Completion Date: 30 September 2016

Vessel Use: Subject to tender, November 2012, 2015

Objective:

1. To estimate the abundance of smooth oreo (*Pseudocyttus maculatus*) in OEO 4 on the Chatham Rise using acoustic survey.

Rationale

The fishery in OEO 4 is the largest smooth oreo fishery in New Zealand with landings of almost 6000 t annually. Based on the current stock assessments for the various oreo fishstocks, smooth oreo in OEO 4 have the largest estimates of current biomass, the largest estimates of sustainable yield, and the largest stock size in relation to virgin biomass (and conversely the lowest level of depletion) of any of the oreo fishstocks. Therefore, it appears that this fishery has the potential to produce the largest sustainable yield over the long term of any of the oreo fishstocks.

The OEO 4 smooth oreo stock assessment was last updated in 2007, and is reported as likely to be above the target biomass level.

The 10-year Deepwater Research Plan has a programme of updating the biomass indices for each of the main oreo fisheries in the New Zealand EEZ every 3 to 5 years. Acoustic surveys have been carried out for smooth oreo in OEO 4 – in 1998, 2001, 2005 and 2009. Therefore, it is proposed to obtain an acoustic biomass estimate for smooth oreo in OEO 4 in 2012 – three years after the previous survey.

The acoustic survey technique has been under development in New Zealand for orange roughy and oreos for a number of years. Issues that still need further work include:

- Determination of target strength of oreos and associated species
- Identification of acoustic targets
- Determination of the optimal survey design, particularly on hills
- Estimation of the apparently large proportion of oreos away from the main aggregations that is found in low background densities.

Objective

It is proposed to estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30% for smooth oreo in OEO 4, using acoustic surveys.

Frequency

This project is scheduled for delivery in 2012–2013 and to be repeated in 2015–2016 and 2018–2019.

Project: Estimation of the abundance of black oreo in OEO3A using acoustic surveys

Project Code: OEO2010/04

Start Date: 1 July 2011

Completion Date: 30 September 2015

Vessel Use: Subject to tender, November 2011, 2014

Objective:

1. To estimate the abundance of black oreo (*Allocyttus niger*) in OEO 3A using acoustic surveys.

Rationale

The black oreo fishery in OEO 3A is the second largest black oreo fishery in New Zealand, with recent landings of over 1500 t per year. The 10-year Deepwater Research Plan has a programme of updating the biomass indices for each of the main oreo fisheries in the New Zealand EEZ every three to five years. Acoustic surveys have been carried out for black oreo in OEO 3A – in 1997, 2002, and 2006. Therefore, it is proposed to obtain an acoustic biomass estimate for black oreo in OEO 3A in 2011 – five years after the previous survey.

The black oreo fishery in OEO 3A has produced an annual catch of about 1600 t in the last 6 years but catch in the previous 10 years averaged 2600 t. The 2008 stock assessment suggested the stock was unlikely to be above the target biomass level.

Previous acoustic surveys divided the area of distribution into three sub-areas (1 - shallow, 2 - intermediate, 3 - deep). Most of the commercial fishing is carried out in Areas 2 and 3 with the big fish usually found in deeper water. For these reasons, previous surveys have focused on those areas. Area 1 is large, contains mostly small black oreo, and is also generally not fished by the commercial fleet. However, most of the mature biomass is in Area 1 based on the acoustic estimate (largely derived from layers containing a mix of species). These mixed species layers are a problem for the acoustic method and require a careful approach since mature fish are so important to the assessment. The composition and vertical extent of layer marks in Area 1 needs to be investigated during the survey.

Objective 1

It is proposed to estimate the abundance with a target coefficient of variation less than or equal to 20-30% for black oreo in OEO 3A, using acoustic surveys.

Frequency

This project is scheduled for delivery in 2011–12 and to be repeated in 2014–2015 and 2017–2018.

Project: Estimating the abundance of orange roughy using acoustic methods (ORH 3B Puysegur)

Project Code: ORH2010/03

Start Date: 1 January 2012

Completion Date: 30 June 2014

Vessel Use: Subject to tender, winter 2012, 2014

Overall Objective:

1. To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) in ORH 3B Puysegur.

Specific Objective:

1. To estimate the abundance with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy over a short time period for the ORH 3B Puysegur.

Rationale

The Puysegur Bank orange roughy fishery developed quickly after spawning aggregations of orange roughy were found during a joint Industry-MFish exploratory fishing survey in 1990–91. However, catches were not sustained and the catch limits were subsequently reduced from the initial level of 5 000 t to only 500 t. The industry implemented a catch limit of 0 t beginning in the 1997–98 fishing year.

The assessment for this stock is very uncertain because the three time series of biomass indices on which it is based are all very short. However, all three series (two of trawl surveys and one of CPUE) suggest that the biomass has been reduced substantially. Estimates of MCY and CAY were 420 t or less. The fishery has been voluntarily closed since 1997–98 and zero catch should allow the stock to move towards B_{MSY}. Genetic data indicate that there are considerable differences between Puysegur fish and fish from the geographically adjacent areas Cook Canyon and Chatham Rise.

The 10-year Deepwater Research Plan has a programme of updating the biomass indices for each of the orange roughy fisheries in the New Zealand EEZ every few years. Stock size is expected to have increased following the voluntary closure, and the intention is to acoustically survey the area during the spawning season and measure the biomass of any spawning plumes found in the area (14 years after the closure).

Objective 1

It is proposed to carry out a survey in 2011 and repeat the survey two years later. The aim of this research project is to estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy.

Frequency

This project is scheduled for delivery in 2011–12 and to be repeated in 2013–2014, 2015–2016 and 2018–2019.

Project: Estimating the abundance of orange roughy using acoustic and trawl methods (ORH7A)

Project Code: ORH2010/04

Start Date: 1 January 2012

Completion Date: 30 June 2015

Vessel Use: Subject to tender, July 2012, 2014

Overall Objective:

1. To estimate the abundance of orange roughy on the southwest Challenger Plateau (ORH7A) and Westpac Bank using acoustic and trawl surveys.

Specific Objectives:

1. To obtain estimates of relative biomass of orange roughy, using acoustic and trawl survey methodology, with target overall survey CVs of 30% or less.

2. To obtain estimates of absolute acoustic biomass from 'clean' orange roughy aggregations over flat areas with target CVs for individual aggregations of 15% or less.

Rationale

The orange roughy fishery in ORH7A commenced in 1981 on the southwest Challenger Plateau. It was carried out both within and outside of the EEZ and managed as a single, straddling stock. An experimental management approach was adopted to test the productivity of the stock that resulted in the TACC being raised to a peak of 12,000 t in 1987-88. It was then progressively reduced to 1,425 t in 1998-99 when the stock assessment estimated the stock had been fished down to below B_{MSY}.

A new stock assessment in 2000 based on a standardised CPUE index, modelled using a stochastic stock reduction model, estimated $B_{current}$ to be at 3% B_0 (where B_0 was estimated to be around 91,000 t). The stock was interpreted to be at about 10% of B_{MSY} and the fishery was closed to fishing from 1 October 2000 (with a TACC of 1 t), to promote stock rebuilding.

In recent years a number of acoustic and trawl surveys have been conducted (2005, 2006, 2009 and 2010). Results from 2010 are not yet available but in 2009 spawning plumes of orange roughy were found and measured acoustically. Further surveys in 2012 and 2014 will be used to measure the abundance and distribution of orange roughy in this area.

Objective 1

Stratified random trawl surveys were conducted in 2005, 2006 and 2009 to determine relative biomass estimates for the mature and total orange roughy respectively. A similar approach will be adopted to maintain comparability with the earlier surveys.

Objective 2

Acoustic methods have been successfully used to gain biomass estimates for spawning aggregations of New Zealand orange roughy in recent years. During the surveys of southwest Challenger Plateau during 2005, 2006 and 2009, acoustic transects were conducted over hills and flat areas, using star and parallel transecting techniques respectively, where the main concentrations of spawning roughy had been found in previous years.

Frequency

This project is scheduled for delivery in 2011–12 and to be repeated in 2013–2014, 2015–2016 and 2018–2019.

Project: Estimating the abundance of orange roughy using acoustic methods (ORH 7B)

Project Code: ORH2010/05

Start Date: 1 January 2015

Completion Date: 30 June 2016

Vessel Use: Subject to tender, winter 2015, 2019

Overall Objective:

1. To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) in ORH 7B WCSI.

Specific Objective:

1. To estimate the abundance of orange roughy (7B spawning plume) with a target coefficient of variation (c.v.) of the estimate of 20-30 % using acoustic survey.

Rationale

This fishery developed after 1983 when spawning orange roughy were found in an area near the Cook Canyon (WCSI) in statistical areas 033, 034 and 705. Up until 1996–97 approximately 80% of the catch was taken in winter (June-July) when fish formed aggregations for spawning. From 1997–98 onwards about 50% of the catch was taken in winter. Catches in the early-mid 1990s (especially 1994–95) were well below the TACC and subsequently the TACC was reduced to 430 t for the 1995–96 fishing year, and then was reduced further to 110 t from 1 October 2001.

An assessment in 2004 using CPUE indices estimated the stock to be at 17%B_0. A further assessment was attempted in 2007 with updated information; however, this was rejected by the working group as the model was insensitive to the CPUE data. The model indicated that the stock had been rebuilding since the mid 1990s, a trend not supported by any observations in the fishery. From 1 October 2007 the TACC for this stock was reduced to 1 t effectively closing the fishery.

The 10 Year Research Plan has a programme of updating the biomass indices for each of the orange roughy fisheries in the New Zealand EEZ every few years. Acoustic surveys have not previously been carried out on this stock. Stock size is expected to have increased following the closure, and the intention is to acoustically survey the area during the spawning season and measure the biomass of any spawning plumes found in the area (eight years after the closure).

Objective

Orange roughy in this fishery are thought to be a single stock. Genetic studies have shown that samples of Cook Canyon orange roughy are significantly different from Challenger Plateau and Puysegur Bank samples. Moreover, the size structure and parasite composition differ from fish on the Challenger Plateau. Spawning occurs at a similar time to fish on the Challenger Plateau and the Puysegur Bank.

It is proposed to carry out a pilot study in 2015 and repeat the survey four years later. The aim of this research project is to estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy.

Frequency

This project is scheduled for delivery in 2015–16 and to be repeated in 2019–2020.

Project: Biomass estimation of southern blue whiting using acoustic surveys (Bounty Platform)

Project Code: SBW2010/02

Start Date: 1 July 2011

Completion Date: 30 June 2015

Vessel Use: Industry vessel, August 2011 (annually)

Overall Objective:

1. To estimate the biomass of southern blue whiting (*Micromesistius australis*) using acoustic surveys.

Specific Objective:

1. To estimate spawning biomass of SBW at Bounty Island during August, using an acoustic survey, with a target coefficient of variation (c.v.) of the estimate of 30 %.

Rationale

This fishery was developed in the early 1970s by the Soviet fleet. Landings have fluctuated considerably, peaking at 75,000 t in the 1991/92 fishing year, when almost 60,000 t was taken from the Bounty Platform stock. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks in SBW6. The TACC for the Bounty Platform stock is currently 15,000 t.

There is uncertainty over the estimate of current stock size. This is due to imprecision in the acoustic data and to uncertainty over recent and future recruitment. The fishery is strongly recruitment driven and is currently dependent on less than five year classes, compared with up to 15 year classes in the past.

The Bounty stock was surveyed by Tangaroa using acoustic methods from 1993 to 2001. The biomass declined over this period and the TACC was reduced to 3500 t. In recent years industry has surveyed the stock acoustically and a good recruitment from the 2002 year class appears to have built up the biomass to possibly more than 100,000 t.

The original research acoustic surveys have been used to measure relative abundance of adult SBW and also to predict pre-recruit numbers in each stock. As the fish recruit at 2 and 3 years to the fishery, surveys are required every two years to keep the assessment up to date. The movement of fish during the survey period has required the development of an adaptive survey design to increase efficiency; alternative survey designs result in different biases in the estimate of biomass.

The recent industry surveys are based on the aggregations that are being fished commercially. Consequently they may be regarded as minimum estimates of biomass as the whole area is not surveyed. This has resulted in very low estimates from some surveys where the fish did not appear to be sampled adequately.

Objective 1

In August 2011 it is proposed to continue the series of aggregations surveys based on industry vessels. The intention is to survey this area annually, as the use of hull-mounted transducers is likely to result in poor data quality in some years from rough weather.

Frequency

This project is scheduled for annual delivery.

Project: Biomass estimation of southern blue whiting using acoustic surveys (Pukaki Rise)

Project Code: SBW2010/03

Start Date: 1 January 2012

Completion Date: 30 June 2015

Vessel Use: Industry vessel, winter 2012, 2014

Overall Objective:

1. To estimate the biomass of southern blue whiting (*Micromesistius australis*) using acoustic surveys.

Specific Objective:

1. To estimate spawning biomass of SBW at Pukaki Rise during winter, using an acoustic survey, with a target coefficient of variation (c.v.) of the estimate of 30 %.

Rationale

The southern blue whiting fishery was developed in the early 1970s by the Soviet fleet. Landings have fluctuated considerably, peaking at 75,000 t in the 1991/92 fishing year, when almost 60,000 t was taken from the Bounty Platform stock. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks in SBW6. The TACC for the Pukaki Rise stock is currently 5,500 t.

There is uncertainty over the estimate of current stock size. This is due to imprecision in the acoustic data and to uncertainty over recent and future recruitment. The fishery is strongly recruitment driven and is currently dependent on less than five year classes, compared with up to 15 year classes in the past.

The Pukaki stock was surveyed by Tangaroa using acoustic methods from 1993 to 2000. Since 1992–93 the catch has never approached the level of the TACC which remains at 5,500 t. In 2009 industry surveyed the stock acoustically and stock size appears to be of a similar magnitude as seen in earlier surveys.

The original research acoustic surveys have been used to measure relative abundance of adult SBW and also to predict pre-recruit numbers in each stock. As the fish recruit at 2 and 3 years to the fishery, surveys are required every two years to keep the assessment up to date. The movement of fish during the survey period has required the development of an adaptive survey design to increase efficiency; alternative survey designs result in different biases in the estimate of biomass.

The recent industry survey was based on the aggregations that were being fished commercially. Consequently they may be regarded as minimum estimates of biomass as the whole area is not surveyed. This can result in very low estimates from some surveys if the fish are not sampled adequately.

Objective 1

In winter 2012 it is proposed to repeat the aggregation survey based on industry vessels and continue with these surveys every two years.

Frequency

This project is scheduled for delivery in 2012–13 and to be repeated in 2014–2015, 2016–2017 and 2018–2019.

Project: Biomass estimation of southern blue whiting using acoustic surveys (Campbell Islands)

Project Code: SBW2010/04

Start Date: 1 January 2011

Completion Date: 30 June 2014

Vessel Use: Subject to tender, September 2011, 2013

Overall Objectives:

1. To estimate the biomass of southern blue whiting (*Micromesistius australis*) using acoustic surveys and to complete a pilot acoustic survey of OEO6.

Specific Objectives:

1. To estimate pre-recruit and spawning biomass at Campbell Island using an acoustic survey, with a target coefficient of variation (c.v.) of the estimate of 30 %.

2. To carry out a pilot acoustic survey of oreo stocks in the OEO6 fishery.

Rationale

Southern blue whiting (SBW)

Fisheries for SBW were developed in the early 1970s by the Soviet fleet. Landings have fluctuated considerably, peaking at 75,000 t in the 1991/92 fishing year, when almost 60,000 t was taken from the Bounty Platform stock. From 1992/93 to 1995/96 an annual catch limit of 32,000 t applied, but this was increased for the 1996/97 fishing year to 58,000 t, as the stock assessment indicated higher yields were available. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks in SBW 6. The TACC for the Campbell Island stock is currently 23,000 t.

There is uncertainty over the estimates of current stock size for all four stocks. This is due to imprecision in the acoustic data and to uncertainty over recent and future recruitment. The fishery is strongly recruitment driven and is currently dependent on less than five year classes, compared with up to 15 year classes in the past.

A time series of acoustic surveys was started in 1993. The acoustic surveys have been used to measure relative abundance of adult SBW and also to predict pre-recruit numbers in each stock. As the fish recruit at 2 and 3 years to the fishery, surveys are required every 2 years to keep the assessment up to date. The movement of fish during the survey period has required the development of an adaptive survey design to increase efficiency; alternative survey designs result in different biases in the estimate of biomass. The last acoustic survey of the Campbell Island stock was completed in September 2009.

Objective 1

In September 2011 the Campbell Island stock will again be surveyed. The time series of acoustic surveys are providing fishery independent monitoring of both the recruited part of the population as well as predicting the strength of year classes about to enter the fishery. Further *in situ* data on target strength may be collected during the survey. Refining the estimates of target strength will allow the absolute abundance of separate age classes to be determined. The catalogue of target strength signatures and target identification information and results should be updated.

Oreos

OEO6 includes separate fisheries at the Bounties and Macquarie Ridge (for smooth oreo mainly) and the Pukaki Rise oreo fishery that takes both species, smooth and black oreo. Total landings of OEO6 have been close to the TACC level since it was raised to 6,000 t in 1996. In recent years over 3,000 t of black oreo has been taken from the Pukaki Rise fishery, but previously, more smooth oreo was landed. This area currently has the largest black oreo fishery in New Zealand.

Objective 2

Oreo species give high resonance to acoustic sounders and are therefore good candidates for surveying by this method. Although the area is remote, the close proximity of this oreo fishery to the Campbell Islands where the SBW survey is being conducted (every two years) affords an opportunity to include the oreo survey as an add-on to the SBW survey. A feasibility trial will be carried out in 2011 and further surveys will depend on the success of the pilot.

Frequency

This project is scheduled for delivery in conjunction with an OEO6 survey as a trial in 2011–2012. If this trial proves successful a combined survey will repeated in the following years 2013–2014, 2015–2016, 2017–2018 and 2019–2020.

If this trial proves unsuccessful then the SBW6I survey will be completed as a single survey but the frequency of the survey will be revised but will likely be scheduled for delivery every two years.

Project: Stock assessment of deepwater and middle depth fish stocks

Project Code: DEE2010/02

Start Date: 01 January 2011

Completion Date: 30 September 2014

Vessel Use: None

Overall Objective:

1. To carry out stock assessments of the major deepwater and middle depth fish stocks, including estimating biomass and sustainable yields.

Specific Objective:

1. To conduct stock assessments, including estimating biomass and sustainable yields, for the stocks listed in Table 1 in the years specified.

Rationale

The 10-year deepwater research plan sets out the timing for resource surveys and subsequent stock assessments of the main fisheries for each year. Depending on the stock, there may be a long historical record of standardised abundance indices from trawl surveys (e.g. hoki) or very little information on the relative or absolute abundance of the stock. In some cases CPUE data are the only abundance indices available for assessments. The stocks also vary in the amount and type of data available (e.g. catch at age or length) to estimate selectivity parameters and year class strength. In the Plenary report, references are provided to Fishery Assessment Reports (FARs) where full details of each stock assessment are described.

The following steps are required to carry out a stock assessment for each stock.

1. Formulate an assumption concerning stock structure for the species and the fisheries that harvest each stock.

The stocks to be assessed are biological stocks that may form part or all of a fishstock or be a combination of one or more Fishstocks. For example, LIN 6 (Bounties) is assessed separately as the Bounty part of the LIN 6 stock, while the rest of LIN 5&6 combined is assessed as the Sub-Antarctic ling stock. Similarly LIN 3&4 are assessed as one biological stock residing on the Chatham Rise.

In most cases, the various working groups have already agreed on the appropriate biological stocks to be assessed in each case and Plenary reports and FARs contain details of the assumed stock structure for each species.

The catch history for each biological stock is an important input to the assessment model and this needs to be determined and may also need to be split up by method of capture in a mixed fishery (e.g. line and trawl fisheries harvesting the same stock).

2. The growth rate and natural mortality assumed for the stock

In many stocks, the ageing has been validated using annual growth rings on the otoliths. Growth may vary between stocks and therefore, where possible, the growth rate needs to be determined separately for each stock. The rate of natural mortality is sometimes estimated within the model but there is generally little information in the data concerning this parameter and more often an assumed value is used based on the longevity of the species.

References to the growth and natural mortality rates for each stock are given in Plenary and FAR reports.

3. Abundance indices

A series of relative abundance indices from CPUE or from research surveys is generally used to model the change in biomass of a stock over time. In a few cases, the abundance index is considered to be an absolute estimate: for example, in acoustic surveys assuming known target strength for the species. Trawl surveys are always used as relative abundance indices.

CPUE is required to be standardised over time to account for any changes in the fishery (changes in the areas fished, vessels used, season of fishery and gear used). Grooming of the catch and effort data is necessary to remove outliers and correct mistakes in the database. In many cases CPUE is not considered proportional to biomass and the indices may not be used where alternative fishery-independent indices are available (e.g. hoki).

For those stock assessments requiring CPUE indices, the researcher will be required to carry out these analyses as part of the stock assessment project. However, other data used in the assessment such as abundance indices from research surveys or catch at age data from the commercial fisheries will be provided by MFish (sourced from other projects). Knowledge of how the fishery operates is generally required to ensure that abundance indices are appropriate.

4. Catch at age or length

The age frequency of the commercial catch is an important data source to be able to estimate the selectivity of the fishing gear within the assessment models. Year class strength for a series of cohorts may also be estimated from these data. Length data is not as informative but still may be useful to estimate the selectivity pattern for the fishing method. The sampling of the deepwater fisheries is carried out by Scientific Observers during commercial fishing operations. A programme of length measurement and otolith sampling operates in each main fishery for the major species.

Table 1 sets out the likely availability of data for each stock assessment in the schedule. Because of the variation in the available data the assessments will vary in complexity. Some

assessments may also require spatially explicit models to fit the data adequately. The Plenary report presents a summary of the main details for each current stock assessment and the data included in the various model runs (FARs provide more detailed information on the stock assessments).

Frequency

Stock assessments will be delivered annually as per the attached table.

Biological stock	Last assessment	Next assessment	Availability of new data					
			Trawl indices	Acoustic indices	CPUE analyses	Catch at age	Catch at length	Other
Stock assessments scheduled to start in 2011								
HOK 1	2010	2011	Chatham Rise Jan 2011 Sub-Antarctic Dec 2010	Cook strait up to 2009 WCSI up to 2010	Nil	Trawl to 2010 (4 areas)		WCSI trawl/acoustic surveys start July 2011
HAK 1	2007	2011	Sub-Antarctic Dec 2010	Nil	Trawl to 2010	Trawl to 2010		
LIN 3&4	2007	2011	Chatham Rise Jan 2011	Nil	Longline to 2010	Longline to 2010 Trawl survey to 2011		
SSO 4	2007	2011	Nil	Nov 2009	Trawl to 2010	Nil	Trawl to 2010	
SBW 6B	2010	2011	Nil	Aug 2010	Nil	Trawl to 2010		
SBW 6R	2002	2011	Nil	Sept 2010	Nil	Trawl to 2010		
Stock assessments scheduled to start in 2012								
LIN 5&6	2007	2012	Sub-Antarctic Dec 2010	Nil	Longline to 2011	Trawl to 2011 Longline to 2011 Trawl survey to 2010		
SSO 1	2007	2012	Nil	Nov 2010?	Trawl to 2011	Nil	Trawl to 2011	Southland fishery
CDL 2	2009	2012	Nil	Apr 2011?	Trawl to 2011	Nil	Trawl to 2011	
SCI 3	Nil	2012	2001 only	Nil	Nil	Nil		Camera surveys 2001 (2) and Sept 2010
SBW 6I	2010	2012	Nil	Sept 2011		Trawl to 2011		
Stock assessments scheduled to start in 2013								
HAK 4	2009	2013	Chatham Rise to Jan 2013	Nil	Nil	Trawl to 2012 Trawl survey to 2012		
HAK 7	2004	2013	WCSI Jul 2012	Jul 2011?	Nil	Trawl to 2012 Trawl survey to 2012		
LIN 7 (WCSI)	2008	2013	WCSI Jul 2012	Nil	Nil	Trawl to 2012 Longline to 2012 Trawl survey to 2012		

Biological stock	Last assessment	Next assessment	Availability of new data					
			Trawl indices	Acoustic indices	CPUE analyses	Catch at age	Catch at length	Other
LIN 2&7 (Cook Strait)	2007	2013	Nil	Nil	Trawl to 2012	Trawl to 2012 Longline to 2012		
SSO 6 (Pukaki)	2006	2013	Nil	Sept 2011	Trawl to 2012	Nil	Trawl to 2012	
BOE 6 (Pukaki)	2009	2013	Nil	Sept 2011	Trawl to 2012	Nil	Trawl to 2012	
ORH 3B (NW CRise)	2006	2013	Nil	Jul 2011*	Trawl to 2012	Nil	Trawl to 2012	
ORH 3B (Puysegur)	1997	2013	Nil	Jul 2011*				Closed since 1997-98
ORH 7A	2010	2013	Jul 2011	Jul 2011		Nil		Fishery may open 2010-11
BOE 3A	2008	2013	Nil	Nov 2011	Trawl to 2012	Survey data to 2011	Trawl to 2012	
SCI 1	Nil	2013	1993-2008 (8)	Nil	Nil	Nil	Survey data Trawl to 2012	Camera surveys 1998-2008 (6) and Mar 2012
SCI 2	Nil	2013	1993-2006 (7)	Nil	Nil	Nil	Survey data Trawl to 2012	Camera surveys 2003-06 (4) and Apr 2012
Stock assessments scheduled to start in 2014								
LIN 6B	2006	2014	Nil	Nil	Longline to 2013	Longline to 2013		
SCI 6A	Nil	2014	Nil	Nil	Nil	Nil		Camera surveys 2007-08 (2) and Apr 2013
JMA 7	2007	2014	Nil	Mar 2012 and 2013	Trawl to 2013	Trawl to 2013		Note : 3 species mix
Stock assessments scheduled to start in 2015								
ORH MEC	2010	2015	ECNI Apr 2014	Nil	Trawl to 2014	Nil	Trawl to 2014	

*Survey results have been equivocal in the past or proposed survey is a prototype.

Project: Characterisation and fishery monitoring of deepwater and middle depth species

Project Code: DEE2010/07

Start Date: 01 July 2011

Completion Date: 30 September 2017

Vessel Use: None

Overall Objectives:

1. To review the status of deepwater and middle depth Fishstocks not routinely assessed. Up to six species will be chosen each year for review.

Specific Objectives (2011-12):

1. To characterise the fisheries by analysis of commercial catch and effort data up to 2010/11.

2. To carry out standardised CPUE analyses for the major fisheries (Fishstocks) where appropriate.

3. To review the indices from CPUE analyses, all relevant research trawl surveys and Observer logbooks to determine any trends in biomass estimates, size frequency distributions or catch rates.

4. To review stock structure using data accessed above and any other relevant biological or fishery information.

5. To assess the availability and utility of developing a series of age frequency distributions from otoliths collected by researchers on trawl surveys or by observers on commercial fishing vessels.

6. To make recommendations on future data requirements (including recommendations for annual levels of observer sampling) and methods for monitoring the stocks.

Rationale

Many deepwater and middle depth fisheries are of moderate size or value compared to hoki, hake, ling, orange roughy, oreo and southern blue whiting fisheries and are not routinely monitored or assessed. This project is designed to ensure that data available for monitoring the moderately important stocks are routinely summarised and assessed on a three year rotating schedule. This will allow for research needs relevant to current management issues to be appropriately assessed.

The proposed suite of stocks to be covered by this project is included in the following table and includes stocks from alfonsino, arrow squid, barracouta, black cardinalfish, blue mackerel, frostfish, southern gemfish, pale and dark ghost sharks, lookdown dory, prawn killer, redbait, ribaldo, rubyfish, sea perch, silver warehou, spiny dogfish, and white warehou. Updating the fishery characterisations for 6 species each year will ensure that they are all updated at least every three years.

(Note: Patagonian toothfish and deepwater crabs may be added to this list in later years but these two species currently have (or are likely to have) research requirements tied in with special permits for exploratory fishing).

The most recent reports on characterisations and other stock assessment research for the species covered by this project are listed in the table below. References to research reports are available in the most recent Plenary report (May 2010).

Species	**Stocks**	**Previous characterisation study**	**Other stock assessment research**
Alfonsino	All	2002 (BYX 3)	AMP review BYX1 2010
Arrow squid	All	2009	MID2008-01 *N. sloanii* Age and growth 1992 (Japanese)
Barracouta	4, 5 & 7	2010	MID2008-01 Tagging 1989 SI stock structure 2002
Black cardinalfish	All	-	CDL2008-01 CPUE and stock assessment of CDL2
Blue mackerel	3 & 7	-	CPUE 2007 Catch at age
Frostfish	3 - 9	2001	Biology, commercial landings 1998
Gemfish – southern	3 & 7	1998	Climate and recruitment 1999
Ghost shark – dark	4, 5 & 6	2003	Ageing technique 2001
Ghost shark – pale	All	2003	Ageing technique 2001
Lookdown dory	All	2010	MID2009-01 Ageing (LDO2004/01)
Patagonian toothfish	All	-	None
Prawn Killer	All	-	None
Redbait	All	2009	None
Ribaldo	3 - 8	2010	MID2009-01 Ageing (RIB2007/01)
Rubyfish	All	-	AMP review RBY1 2010
Sea perch	3 - 7	2007 (SPE3)	AMP review SPE3 2008
Silver warehou	All	2008 (SWA 3 & 4)	MID2007-03 Stock structure 2001 Ageing methodology 1996
Spiny dogfish	4 & 5	2004	None
White warehou	All	2005	Ageing & stock assessment 1999
Deepwater crabs	All	-	None

Objectives 1 to 6

It is proposed that observer sampling be augmented the year before the characterisation study to obtain more data for the analyses required. Under the 10 Year Research Programme the following schedule of characterisations is proposed for the next 3 years.

Year	Characterisations					
2010-11	Observer data collection required					
2011-12	EMA	BYX	FRO	WWA	GSP	SPE
2012-13	RBY	PRK	SKI	SPD	RBT	GSH
2013-14	SWA	BAR	LDO	RIB	SQU	CDL

Frequency

Stock characterisations are scheduled to occur annually from 2011–2012 following the three year sequence specified in the table above.

Project: Estimating the abundance of scampi in SCI 1 using photographic surveys

Project Code: SCI2010/02

Start Date: 1 July 2011

Completion Date: 30 June 2016

Vessel Use: Subject to tender, March 2012, 2015

Overall Objective:

1. To estimate the abundance of scampi (*Metanephrops challengeri*) in SCI 1.

Specific Objectives:

1. To estimate the relative abundance of scampi using photographic techniques in SCI 1.

2. To estimate growth of scampi from tagging in SCI 1.

Rationale

The scampi fishery is based on the species *Metanephrops challengeri,* which is widely distributed around New Zealand. The total scampi landings in 2008/09 were 594 t (limit 1,291 t). The landings for scampi in SCI 1 were 86 t (TACC 120 t) in 2008/09. The other major fisheries are SCI 2 (TACC 200 t), SCI 3 (TACC 340 t), and SCI 6A (TACC 306 t). SCI 4A has a TACC of 120 t but less than 1 tonne was landed in 2008/09. Scampi are taken by light trawl gear, which catches the scampi that have emerged from their burrows. Emergence rates, and therefore catch rates, vary over daily and longer cycles. The main fisheries are in waters 300–500 m deep. Little is known about the growth rate and maximum age of scampi. Available information is that scampi are quite long lived.

Stock assessment of scampi is problematical and there are contradictory trends between CPUE indices and photographic surveying. The use of CPUE indices in stock assessments has been questioned because of concerns that changes in these indices may be strongly influenced by changes in catchability caused by the behaviour of scampi rather than by changes in abundance. Photographic surveying has been used extensively to estimate the abundance of the European scampi. Photographic surveying has been carried out in New Zealand since 1998. To date, data from six surveys in SCI 1 are available (1998 & 2000 – 2003, 2008).

A reliable stock assessment and subsequent determination of the status of the stock in relation to the B_{MSY} is not currently possible for any scampi stock. The management and stock assessment approach for scampi is to develop a time series of relative abundance indices for the major scampi fisheries in an effort to better understand the status of scampi in each fish stock, and to develop a model for a quantitative stock assessment.

Photographic surveys are required on a regular basis for selected scampi stocks to provide indices of relative abundance.

Objective 1

This objective will undertake photographic surveys to estimate the relative abundance of scampi in SCI 1. The establishment of an ongoing time series of abundance estimates derived from photographic surveys for the major scampi stocks has been accepted by the Shellfish Fishery Assessment Working Group as an important component in the stock assessment of scampi.

Objective 2

The length-based stock assessment model that has been developed for SCI 1 shows that the model approach is limited by information on growth. Better information on scampi growth is required for all scampi stock assessments as they are progressively developed for each major scampi stock. This Objective would undertake tagging scampi as part of the programme on estimating abundance from photographic surveys in Objective 1. Information from tagging may also provide additional data for fitting a tag-based estimate of absolute abundance or biomass within the stock assessment model.

Frequency

This project is scheduled for delivery in 2011–12 and to be repeated in 2014–2015, and 2017–2018.

Project: Estimating the abundance of scampi in SCI 2 using photographic surveys

Project Code: SCI2010/03

Start Date: 1 July 2011

Completion Date: 30 June 2016

Vessel Use: Subject to tender, April 2012, 2015

Overall Objective:

1. To estimate the abundance of scampi (*Metanephrops challengeri*) in SCI 2.

Specific Objectives:

1. To estimate the relative abundance of scampi using photographic techniques in SCI 2.

2. To estimate growth of scampi from tagging in SCI 2.

Rationale

The scampi fishery is based on the species *Metanephrops challengeri,* which is widely distributed around New Zealand. The total scampi landings in 2008/09 were 594 t (limit 1,291 t). The landings for scampi in SCI 2 were 52 t (TACC 200 t) in 2008/09. The other major fisheries are SCI 1 (TACC 120 t), SCI 3 (TACC 340 t), and SCI 6A (TACC 306 t). SCI 4A has a TACC of 120 t but less than 1 tonne was laded in 2008/09. Scampi are taken by light trawl gear, which catches the scampi that have emerged from their burrows. Emergence rates, and therefore catch rates, vary over daily and longer cycles. The main fisheries are in waters 300–500 m deep. Little is known about the growth rate and maximum age of scampi. Available information is that scampi are quite long lived.

Stock assessment of scampi is problematical and there are contradictory trends between CPUE indices and photographic surveying. The use of CPUE indices in stock assessments has been questioned because of concerns that changes in these indices may be strongly influenced by changes in catchability caused by the behaviour of scampi rather than by changes in abundance. Photographic surveying has been used extensively to estimate the abundance of the European scampi. Photographic surveying has been carried out in New Zealand since 1998. To date, data from four surveys in SCI 2 are available (2002–2006).

A reliable stock assessment and subsequent determination of the status of the stock in relation to the B_{MSY} is not currently possible for any scampi stock. The management and stock assessment approach for scampi is to develop a time series of relative abundance indices for the major scampi fisheries in an effort to better understand the status of scampi in each fish stock, and to develop a model for a quantitative stock assessment. Photographic surveys are required on a regular basis for selected scampi stocks to provide indices of relative abundance.

Objective 1

This objective will undertake photographic surveys to estimate the relative abundance of scampi in SCI 2. The establishment of an ongoing time series of abundance estimates derived from photographic surveys for the major scampi stocks has been accepted by the Shellfish Fishery Assessment Working Group as an important component in the stock assessment of scampi.

Objective 2

The length-based stock assessment model that has been developed for SCI 1 shows that the model approach is limited by information on growth. Better information on scampi growth is required for all scampi stock assessments as they are progressively developed for each major scampi stock. This Objective would undertake tagging scampi as part of the programme on estimating abundance from photographic surveys in Objective 1. Information from tagging may also provide additional data for fitting a tag-based estimate of absolute abundance or biomass within the stock assessment model.

Frequency

This project is scheduled for delivery in 2011–12 and to be repeated in 2014–2015, and 2017–2018.

Project: Estimating the abundance of scampi in SCI 6A using photographic surveys

Project Code: SCI2010/04

Start Date: 1 July 2012

Completion Date: 30 June 2017

Vessel Use: Subject to tender, April 2013, 2016

Overall Objective:

1. To estimate the abundance of scampi (*Metanephrops challengeri*) in SCI 6A.

Specific Objectives:

1. To estimate the relative abundance of scampi using photographic techniques in SCI 6A.

2. To estimate growth of scampi from tagging in SCI 6A.

Rationale

The scampi fishery is based on the species *Metanephrops challengeri,* which is widely distributed around New Zealand. The total scampi landings in 2008/09 were 594 t (limit 1,291 t). The landings for scampi in SCI 6A were 264 t (TACC 306 t) in 2008/09. The other major fisheries are SCI 1 (TACC 120 t), SCI 2 (TACC 200 t), and SCI 3 (TACC 340 t). SCI 4A has a TACC of 120 t but less than 1 tonne was landed in 2008/09. Scampi are taken by light trawl gear, which catches the scampi that have emerged from their burrows. Emergence rates, and therefore catch rates, vary over daily and longer cycles. The main fisheries are in waters 300–500 m deep. Little is known about the growth rate and maximum age of scampi. Available information is that scampi are quite long lived.

Stock assessment of scampi is problematical and there are contradictory trends between CPUE indices and photographic surveying. The use of CPUE indices in stock assessments has been questioned because of concerns that changes in these indices may be strongly influenced by changes in catchability caused by the behaviour of scampi rather than by changes in abundance. Photographic surveying has been used extensively to estimate the abundance of the European scampi. Photographic surveying has been carried out in New Zealand since 1998. To date, data from two surveys in SCI 6A are available (2007 and 2008).

A reliable stock assessment and subsequent determination of the status of the stock in relation to the B_{MSY} is not currently possible for any scampi stock. The management and stock assessment approach for scampi is to develop a time series of relative abundance indices for the major scampi fisheries in an effort to better understand the status of scampi in each fish stock, and to develop a model for a quantitative stock assessment.

Photographic surveys are required on a regular basis for selected scampi stocks to provide indices of relative abundance.

Objective 1

This objective will undertake photographic surveys to estimate the relative abundance of scampi in SCI 6A. The establishment of an ongoing time series of abundance estimates derived from photographic surveys for the major scampi stocks has been accepted by the Shellfish Fishery Assessment Working Group as an important component in the stock assessment of scampi.

Objective 2

The length based stock assessment model that has been developed for SCI 1 shows that the model approach is limited by information on growth. Better information on scampi growth is required for all scampi stock assessments as they are progressively developed for each major scampi stock. This Objective would undertake tagging scampi as part of the programme on estimating abundance from photographic surveys in Objective 1. Information from tagging may also provide additional data for fitting a tag-based estimate of absolute abundance or biomass within the stock assessment model.

Frequency

This project is scheduled for delivery in 2012–13 and to be repeated in 2015–2016, and 2018–2019.

Project: Estimating the abundance of scampi in SCI 3 using photographic surveys

Project Code: SCI2010/05

Start Date: 1 January 2013

Completion Date: 30 June 2014

Vessel Use: Subject to tender, September 2013

Overall Objective:

1. To estimate the abundance of scampi (*Metanephrops challengeri*) in SCI 3.

Specific Objectives:

1. To estimate the relative abundance of scampi using photographic techniques in SCI 3.

2. To estimate growth of scampi from tagging in SCI 3.

Rationale

The scampi fishery is based on the species *Metanephrops challengeri,* which is widely distributed around New Zealand. The total scampi landings in 2008/09 were 594 t (limit 1,291 t). The landings for scampi in SCI 3 were 190 t (TACC 340 t) in 2008/09. The other major fisheries are SCI 1 (TACC 120 t), SCI 2 (TACC 200 t), and SCI 6A (TACC 306 t). SCI 4A has a TACC of 120 t but less than 1 tonne was landed in 2008/09. Scampi are taken by light trawl gear, which catches the scampi that have emerged from their burrows. Emergence rates, and therefore catch rates, vary over daily and longer cycles. The main fisheries are in waters 300–500 m deep. Little is known about the growth rate and maximum age of scampi. Available information is that scampi are quite long lived.

Stock assessment of scampi is problematical and there are contradictory trends between CPUE indices and photographic surveying. The use of CPUE indices in stock assessments has been questioned because of concerns that changes in these indices may be strongly influenced by changes in catchability caused by the behaviour of scampi rather than by changes in abundance. Photographic surveying has been used extensively to estimate the abundance of the European scampi. Photographic surveying has been carried out in New Zealand since 1998. To date, data from three surveys in SCI 3 are available (2 in 2001 and another in 2002), but a surveyed is planned for September 2010 (SCI2010/01).

A reliable stock assessment and subsequent determination of the status of the stock in relation to the B_{MSY} is not currently possible for any scampi stock. The management and stock assessment approach for scampi is to develop a time series of relative abundance indices for the major scampi fisheries in an effort to better understand the status of scampi in each fish stock, and to develop a model for a quantitative stock assessment.

Photographic surveys are required on a regular basis for selected scampi stocks to provide indices of relative abundance.

Objective 1

This objective will undertake photographic surveys to estimate the relative abundance of scampi in SCI 1. The establishment of an ongoing time series of abundance estimates derived from photographic surveys for the major scampi stocks has been accepted by the Shellfish Fishery Assessment Working Group as an important component in the stock assessment of scampi.

Objective 2

The length based stock assessment model that has been developed for SCI 1 shows that the model approach is limited by information on growth. Better information on scampi growth is required for all scampi stock assessments as they are progressively developed for each major scampi stock. This Objective would undertake tagging scampi as part of the programme on estimating abundance from photographic surveys in Objective 1. Information from tagging may also provide additional data for fitting a tag-based estimate of absolute abundance or biomass within the stock assessment model.

Frequency

This project is scheduled for delivery in 2013–14 and to be repeated in 2016–2017, and 2019–2020.

Project: Taxonomic identification of benthic samples

Project Code: DAE2010/01

Start Date: 1 July 2011

Completion Date: 30 June 2016

Vessel Use: None

Overall Objective:

1. To identify benthic invertebrates in samples taken during research trawls and by observers on fishing vessels.

Specific Objectives:

1. To identify benthic invertebrates in samples taken during research trawls and by observers on fishing vessels.

2. To update relevant databases recording the catch of invertebrates in research trawls and commercial fishing.

Rationale

Five of the seven management objectives related to the Environment Outcome in the draft deepwater fisheries plan are relevant to the management of benthic systems and their fauna (including protected corals):

MO2.3 *Protect habitats of particular significance for fisheries management*
MO2.4 *Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on incidental bycatch species*
MO2.5 *Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long term viability of protected, endangered and threatened species*
MO2.6 *Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on biological diversity*
MO2.7 *Manage effects from the impact of deepwater fishing activity on the benthic habitat using a spatial management approach.*

Assessing the extent to which management action is required to meet these objectives will require knowledge and assessment of the risks in each case. This project will provide for the identification and enumeration of benthic invertebrates in accumulated samples taken during research trawls and by observers on deepwater fisheries vessels.

Objectives 1 & 2

Samples of benthic invertebrates have been taken during research trawl surveys and accumulated for several years. Observers also collect information on benthic invertebrates on board fishing vessels and, although they have been able to identify an increasing proportion of such material at sea using field guides, some problematic material is still returned for identification. The amount of such material is likely to increase if observer coverage increases as anticipated. Not all of the material returned from research trawls and by observers has been sorted and identified, and this project provides for such processing in 2011/12 and 2015/16. Invertebrates should be identified to the lowest feasible taxonomic level, counted, and the information reported in relevant databases.

Frequency

This project is scheduled to be delivered in 2011–2012 and to be repeated 2015–16.